Full-Context Videos for First-Time, Non-Literate PC Users

Indrani Medhi and Kentaro Toyama

Abstract— **This paper presents the use of full-context video to motivate and aid non-literate, first-time users of PCs to successfully navigate a computer application with minimal assistance. Following previous work focused on non-literate users, we observed that in spite of our subjects' understanding of the UI mechanics, they experienced barriers beyond illiteracy in interacting with the computer: lack of awareness of what the PC could deliver, fear and mistrust of the technology, and lack of comprehension about how information relevant to them was embedded in the PC.**

In this paper, we address these challenges with full-context video, which includes dramatizations of how a user might use the application and how relevant information comes to be contained in the computer, in addition to a tutorial of the UI. In experiments conducted with 35 non-literate residents of Bangalore slums, the introduction of full-context video dramatically improved task completion for a job-search task.

Index Terms— **Full-context video, illiterate users, text-free user interfaces**

I. Introduction

There is increasing interest in applications of computers for serving economically poor populations, the goal being to find ways for technology to alleviate poverty and boost socio-economic development [[12], [15], [18], [19], [20], [21]]. For example, the *e-choupal* project in India, seeks to connect village farmers with the Internet, ultimately providing them with a direct connection to a large agriculture conglomerate that pays more for produce than inefficient local markets [[15]]. There are also attempts to streamline processes for rural microfinance institutions – small, non-formal organizations that provide credit to poor agrarian households – using mobile phones as data-entry units [[19], [20]].

One of the greatest challenges faced in developing such applications is that potential users may lack any significant formal education. Conservative estimates of illiteracy, for example, suggest that anywhere from one to two billion people in the world are completely non-literate [[16]], and more are semi-literate – able to read only with great difficulty and effort.

In previous work, we considered the problem of user interfaces for non-literate users and arrived at several design principles for text-free interfaces meant for non-literate users [[17]]. These principles encourage extensive use of semi-abstracted cartoons, voice annotation, and a consistent help avatar. We couched this work in the framework of a simple job-search application, which we knew to be of relevance to our subjects from concurrent ethnographic studies. However, during formal user studies of our prototype UI, we discovered that in spite of our subject's intellectual understanding of the user interface, their completion rate for accomplishing even very simple tasks remained abysmally low.

In subsequent work, which we report for the first time in this paper, we found through detailed questioning of the subjects of the earlier research that illiteracy was only one of several barriers that they faced in using a PC. In particular, subjects expressed (1) lack of awareness of what the PC could deliver, (2) fear and mistrust of the technology, and (3) lack of comprehension about how relevant information was embedded in the PC for them to access. In particular, we note that these barriers persisted in spite of repeated verbal prompts that were specifically meant to override these issues.

We therefore decided to recast our problem from the earlier one of identifying design principles for non-literate users, to the following: *How can we design user interfaces for first-time computer users with little or no formal education (who are likely non-literate), such that on first contact with a PC, they could immediately realize useful interaction?*

In this paper, we present one solution to this problem – the use of a *full-context video* that is looped at the beginning of the application in which an explanation of the broader context of the application is concatenated with instructional material about how to use the application. By "full-context," we mean content that includes not only technical instruction on how to use the interface, but also dramatizations of the scenario in which the application would be useful and how the relevant data was ultimately input into the computer. While the use of video itself for tutorial instruction is neither technically nor conceptually novel [[9], [10], [23]], to our knowledge, work so far has not addressed the need for the particular type of content that we are advocating, for the target population that we are designing for.

Results from our usability tests, conducted with residents of Bangalore slums, most of whom were completely non-literate, suggest that a full-context video makes a dramatic difference in task completion.

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Before proceeding to the main content of the paper and the experimental results, we quickly describe our target community and give background on the job-search application which was our test domain.

II. Target Community and Trial Subjects

We conducted our studies in three urban slum communities in Bangalore, India. To gain access into these communities, we worked with a non-governmental organization (NGO) called Stree Jagruti Samiti, which has an established presence in these three slums for 15 years. Stree Jagruti Samiti works primarily with the women and children in the slums.

All of the subjects we worked with had the three traits we sought to address in our work: (1) functional illiteracy or semi-literacy; (2) low levels of formal education (highest education attained being schooling up to the sixth grade); and (3) no experience whatsoever using a computer.

The set of communities we work with has its own unique characteristics, and so we caution against over-generalization of the results we present later. For example, populations differ in terms of their attitudes toward illiteracy. Our subjects were very frank with respect to illiteracy, attaching no shame to the inability to read; this is unlike illiterate individuals in developed countries who often hide their inability. Also, our subjects held strong associations of the English language (which they did not speak for the most part) with wealth and prestige – both a holdover from colonial British rule, as well as a modern-day fact due to the economic opportunities available to English speakers. These characteristics might have had an effect on our results which would be different for subjects drawn from other locations and cultures. Finally, we note one shared trait that could be the cause of some absolute bias in our results: All of our test subjects were women. We expect, however, that these facts do not affect the *relative* comparisons that our experiments revealed.

The state of illiteracy, poor education, and ignorance about computer technology unites our subjects, and we felt most of the other specifics of our target group were neutral with respect to the studies we conducted; we list them here for the sake of full disclosure: Most of the subjects were female household workers who clean private homes, wash dishes, and so forth. The male members of the households are usually daily wage laborers like plumbers, carpenters, construction workers, mechanics, or fruits and vegetable vendors. Their primary language of communication is Kannada, but many speak additional languages such as Hindi, Tamil, or Telegu. The average household income was INR 800 - INR 3000 (approximately USD 18 – USD 67) per month. Some had television sets, music players and gas burners, but these were not owned by all households. Some subjects had seen computers in the houses of their employers, but due to class and caste-based discrimination, were prohibited from touching the computer (even for the purposes of cleaning!).

Figure 1. Site visit: at the houses of our target users.

III. Domain: Job-Search Application

Although our ultimate objective is to learn general principles of design for non-literate, first-time computer users, we needed a domain in which to begin our investigations. Unstructured interviews with a sample of our target users revealed that one category of information that they all wanted was availability and terms of domestic-labor jobs in their neighborhood. This has since been confirmed informally, in that almost all of the women that we have worked with have expressed the desire to use our job search system, once exposed to it.

We note that the predominant system for finding jobs in these communities is based entirely on word-of-mouth, and that the women find jobs through friends and relatives, and through certain members of the community who make it their (informal) business to gather and trade job information. There is no formal mechanism, whether with brick-and-mortar offices, online, or otherwise, that the women are familiar with. Visits we have made to poor neighborhoods in other cities suggest that this situation is not uncommon, at least in India.

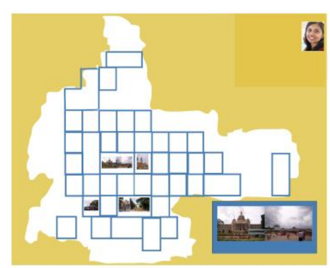
IV. Summary of Previous Work

The core problem addressed in this paper was identified in follow-up interviews after work we had performed to develop a text-free user interface. A very brief summary of this earlier work is presented here to lay context.

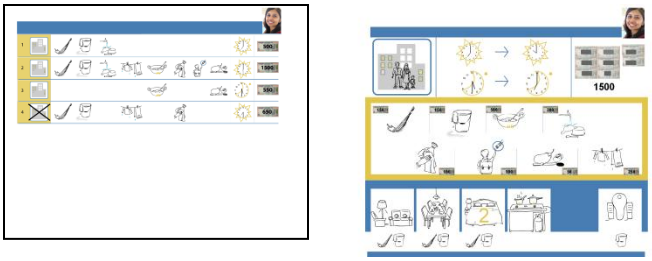
In previous work, we used an iterative design process to determine that the following design elements were suitable for non-literate users: semi-abstracted cartoon graphics, voice annotations on all UI elements, total absence of text (except for numbers, which our subjects could read and write), and a consistent help icon.

Our work was embedded in the aforementioned employment-search application which, using our text-free UI elements, aimed to provide information about prospective jobs to domestic helpers. The jobs could be selected based on location and wages. **Figure 2** shows screenshots from our test application.

introduction page



location page



job listing page job description page

Figure 2. Screenshots from the text-free job-search application.

V. USER TESTING ROUND 1

We conducted initial tests of the job-search application, comparing a text-based UI with standard menu-based layout, with our text-free UI, as shown in **Figure 2**. Both versions contained the same content and the same branching behavior, so that we could isolate the differences due to interface design.

The goal of this first round of tests was to understand whether subjects were able to navigate the employment search application UI and in the process verify that the specific design elements were viable for a non-literate audience.

We set up a task in which subjects were supposed to find a job for an unemployed friend that was the best-paying and closest to their neighborhood.

Results of the test were positive, if obvious: Non-literate users were simply unable to make sense of the text-based UI. Worse, many simply refused to try the text-based UI outright. With text-free UI, subjects were at least willing to engage with the application, and many were able to make some progress in the assigned tasks.

We concluded this round of work with the knowledge that text-free user interfaces were of some value to non-literate users, but that there remained deeper issues that our direct handling of illiteracy left unaddressed. In particular, we were left wondering why our users required a lot of prompting and handholding, even though they understood the mechanics of the text-free UI.

During our Round 1 tests, we observed that our subjects consistently hesitated to proceed with the assigned tasks on the computer. Moreover, repeated verbal encouragement and explanation as to the purpose and use of the application seemed to be of little help. Subjects seemed confused and reluctant throughout the trials.

Unstructured interviews since the tests revealed that our subjects understood the working of the UI – indeed, even novice users were able to manipulate the cursor and click on icons. They were, however, unable to get past certain issues:

- Because word of mouth and informal social networks are the means by which the subjects normally gathered job information, all subjects were puzzled as to the value of a device like a computer for job search, in spite of their understanding of the individual UI elements. The gap between their familiar, routine way of acquiring information and an unfamiliar, high-tech solution could not be bridged by verbal explanations alone.
- Some of the subjects expressed a fear that they would break the computer through misuse, and hesitated to touch the PC at all. This effect varied from subject to subject, but it was particularly true among older subjects.
- Finally, one point seemed to be an issue for all subjects: no one understood how the information they were looking for (available jobs), could possibly be available on a machine unaccompanied by human sources of information. Because they lacked faith that the relevant information was contained within the computer, they had no motivation to interact with the PC in the first place.

These points are easy to underestimate but difficult to overemphasize, and so we ask the reader to excuse a relevant, if pedantic, thought experiment: Imagine if aliens from a technologically advanced world approached us with a thin glass cube and told us that the device would produce any food item we wished if we stood on the cube and silently spelled out the recipe in our minds. Most of us would probably experience issues analogous to those outlined above, much of which might be dispelled if the aliens were to explain to us the technology behind the device. Incidentally, this point illustrates one example of how the user's cognitive model of a technology is not only critical for usability, but critical for belief in the value of application.

In any case, these problems caused mental blocks for our subjects that posed barriers beyond illiteracy. We realized, in fact, that these issues preceded illiteracy in importance, and that the fundamental issues were not strictly "usability" as such, but rather issues of context awareness and motivation.

VI. SOLUTION: FULL-CONTEXT VIDEO

Initially, we tried to solve these problems through extended voice narration in the help icon. Building on the initial voice content in which technical instructions were given (e.g., "Press on the blinking picture of the woman sweeping to continue."), we added background context about the application (e.g., "If you are interested in finding information about available jobs in your neighborhood, this computer program will help you do so."). This had minimal effect, however, in terms of providing motivation. As might be expected, these were less effective than prompting with similar content delivered by actual people.

We then considered use of video, which has an established tradition as a medium of instruction. Through our ethnographies of the target community, we knew that many had television sets in their houses and that the women regularly watched soap operas and movies that were aired in the local TV channels. It was evident that dramatized video was a familiar medium of communication. This fact pointed us toward the potential value of video in the UI, and we experimented with instructional videos that would teach users how to use the application.

An early version of our video experiments consisted of over-the-shoulder shots (consisting entirely of shots as seen in Shot 5 of **Figure 3**), in which live screenshots illustrated use of the application. There was voiceover narration which explained how to click, how to proceed to the next window, and so on. Repeated iterations with our subjects showed, however, that playing such a video prior to application use was of only marginal benefit in task completion; again, understanding how to use the technology was not the problem. After further exploration and discussion, we tried a *full-context video* explaining the broader context of the application in addition to the instructional material about how to use the application. The video had dramatizations of the scenario in which the application would be useful and how the relevant data was ultimately input into the computer. Discussions with some of our subjects suggested that it was important to provide the motivational context (*i.e.*, seeing someone secure a job) as well as the technological context (*i.e.*, how information was accumulated in the computer). We added both, and the storyboard for the particular sequence we arrived at is shown in **Figure 3** (totaling 5 minutes 16 seconds).

1 

Opening: There is a middle class couple looking for a domestic helper but cannot find one.
(Setting the motivational context.)

2 

The husband knows about an application which could help them. They feed their specific requirements into the application.
(Demonstrating how information is input into the computer.)

3 

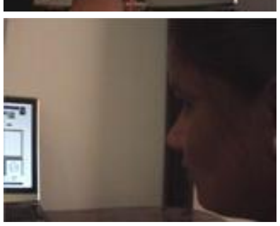
There is a helper who has been looking for a job for the past one month but cannot find one.
(Encouraging identification with a peer.)

4 

An NGO worker tells her that there is an application which could help her find a job.
(Explaining why the application is helpful.)

5 

At the NGO office she gives a demo to the helper on how to navigate through the application.
(Providing instruction on the UI mechanics.)

6 

At the end of this process, the helper finds the information of a job that she really likes which happens to be the one the middle class couple had posted.

7 

She takes the address and the next morning, she arrives at the house of that couple. They meet and the helper gets the job.
(Completing motivational context.)

Figure 3. Storyboard for the full-context video preceding the job-search application.

We inserted the full-context video into the first screen of the application, and it runs in a loop at the beginning of the application. On clicking the movie, the user can proceed to the introduction page as mentioned in the initial application section.

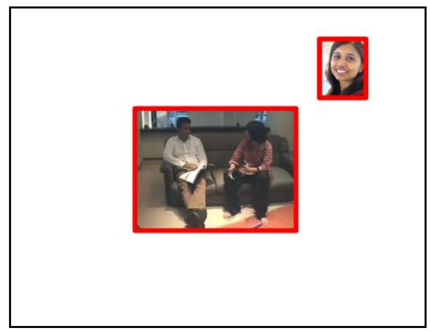


Figure 4. Full-context video set to loop at the beginning of the application.

VII. User-Testing Round 2

Preliminary interactions with our prototype subjects suggested that the full-context video made a world of difference for our target users. Our hypothesis is that the full-context video would provide sufficient information and motivation to encourage first-time, non-literate users toward task completion. To verify this formally, we conducted a comparative test of the employment-search application with three configurations: one that was text-based, one that was text-free with full-context video and one that was text-free without video. The main purpose of these tests was to determine the relative advantage of the application with full-context video versus without it. (We included the text-based configuration not only to provide a baseline, but also to confirm that subjects were, in fact, functionally illiterate and computer illiterate. As noted earlier, unlike in countries where literacy is the norm, non-literate Indians are more than forthcoming about their illiterate or semi-literate status. Depending on the context, some who can read reasonably well will still claim illiteracy because they are not fluent readers of books.)

A. Method

Our subjects were drawn from the same community as described in the earlier target-community section, and with all new participants. 35 subjects were chosen with as little demographic bias as possible, in consultation with the NGO we worked with. We selected women who spanned the range of affluence represented in the community, drawing women who were either Hindu or Muslim. We also chose a range of ages, ranging from 18 to 55 (as reported). All of the subjects spoke Kannada, and over half spoke other Indian languages. All of our subjects were non-literate or at most semi-literate (could write their names, read isolated words and do some basic addition), according to self-reports. No subject had previous exposure to computers, but all were familiar with the use of pay phones and TVs.

All subjects were tested on all three versions of the application (text-based, text-free with movie, and text-free without movie), with text-based UI first, and then the two text-free versions in randomized order. These applications are exactly as presented in the previous sections, with screenshots as in **Figure 2** and **Figure 4**. 17 of the subjects were presented with the non-video version of the text-free UI first ,and 18 of the subjects saw the full-context-video version first. To measure any lasting effects of the full-context-video, we also had subjects try the alternate version of the experiment at a later time, with a minimum gap of two hours between the two text-free versions, during which time, the subjects did not interact with the PC at all. (Since the two text-free UIs differ only in the presence of the full-context video, there are undoubtedly interference effects. This is discussed further below with the results.)

In all instances, subjects were asked to sit in front of a PC running the application. They were asked to name a good friend in their neighborhood. They were then given the following verbal instructions: "Your friend, *X*, has been without work for several weeks and is looking for a house-cleaning job. You've heard that the Stree Jagruti Samiti office [the NGO] has a computer that can help you find jobs, and so you've come to the office. Your friend wants to find the best-paying job that is located in their own neighborhood. Can you help her?" This mode of inquiry dispels the "test-taking" feeling that some subjects have, and reduces performance anxiety.

They were then given up to fifteen minutes to complete the task. If the task was completed within fifteen minutes, the total time taken was recorded. If the subject took longer than fifteen minutes, the task was considered incomplete. (In these cases, subjects were often allowed to continue to completion to protect their pride among their peers, but events beyond the fifteen-minute mark were not recorded.)

During a session, if the subject either appeared lost for a period of 10 seconds, or if they explicitly asked for help twice in succession (each first instance for a help request was met with a mute, encouraging gesture), the test administrators prompted them with verbal encouragement. For each such instance, verbal prompts began with diffuse questions (e.g., "What do you think you should do next?") and proceeded toward more concrete help ("How about if you click on the smiling face?"). The number of prompts per session per subject was also recorded.

B. *Quantitative Results*

Overall, the tests demonstrate the considerable power of full-context video in removing motivational obstacles to using a PC application for non-literate first-time PC users. Summary results are given in TABLE , with raw data in

First, as expected, only 6% (2 people) of the total number of subjects who took the test, could make sense of the text-based UI (See Table 2). These users were quite literate, despite our initial screens for non-literate users. The others were totally unable to make progress on the text-based UI even with significant prompting and encouragement.

Of the 17 subjects who saw the text-free UI without video first, only one (6%) was able to complete the task at all, taking 11 prompts and 8.2 minutes to complete the text-free UI without video version. This is consistent with our results from the previous study – subjects made progress on the UI, but few ultimately took the task to completion.

Of the 18 subjects who saw the text-free UI with video first, we were pleased to find that 100% completed the task, with an average of 4.7 prompts and 6.5 minutes completion time in the text-free UI with video version. This clearly shows the value of the full-context video.

TABLE I
IMPACT ANALYSIS OF VIDEO USAGE

	Without Video (B)	With Video (C)
Task Completed (out of 35)	8	35
Prompts reqd for completion	9.8	5.2
Avg completion time (min)	9.01	4.59
Sequence -	BC	
Task Completed - BC	1	17
Prompts reqd for completion	11	5.9
Avg completion time (min)	8.2	8.6
Sequence -	CB	
Task completed - CB	7	18
Prompts reqd for completion	6	4.7
Avg completion time (min)	10.8	6.5

There is also some enduring impact of the full-context video for users who encountered the same UI without the video a couple of hours later. In particular, of the 18 subjects who were exposed to the video version first, 7 subjects (39%) were able to complete the task the second time without video, when seeing it several hours later, up dramatically from the only 6% for subjects who had not seen the video first.

At the same time, this result means that 61% of the participants did *not* benefit from having seen the video previously when they were exposed hours earlier to the non-video version. Thus, the impact of the video was not permanent for most subjects, suggesting that users might benefit from repeated viewing of full-context video.

We next compare the subjects who managed to complete the task in both cases. This is a biased comparison in that of the 8 subjects who completed both, 7 had seen the video version first, but the bias is "conservative" with respect to the value of full-context video, and so actual improvement with video is likely to be even stronger than observed. The average number of prompts required for the non-video version was almost double that with video (average 6.6 prompts versus 3.8). Average time taken for completion of the task without video was also double as compared to with video (9 min versus 4.5 min). Video thus not only increases the subjects' motivation, but also improves their performance at task completion.

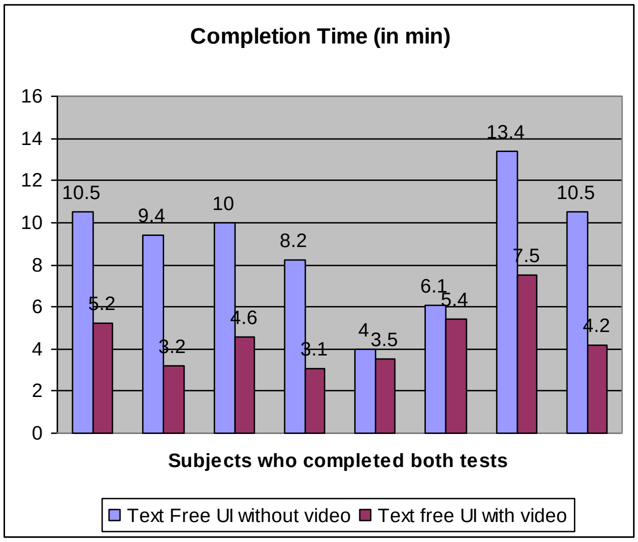


Figure 5. Completion time comparison for subjects who completed the task successfully in both text-free UI with video and without video.

All of our quantitative results thus not only confirm our earlier findings about the viability of text-free UIs for non-literate users, but they suggest that full-context video is a powerful addition to the arsenal of design elements we can use for addressing non-literate users.

C. *Qualitative Observations and Post-Feedback Study*

Throughout our design iterations and formal subject studies, we also made a number of informal qualitative observations. These were not established with countable metrics, but we list them here, because they provide additional context and point towards future work.

Several observations confirm the results from our earlier study. We observed that both our non-literate and semi-literate subjects became very anxious when we showed them the text-based UI. Even subjects who could read isolated words needed significant prompting. It was also the case that among those who completed the task, either with or without video, the mechanics of the UI were not a significant barrier. Women who had never before seen a computer before were still able to manipulate the graphical UI within minutes of first exposure.

Concerning the use of full-context video, we also made a number of qualitative observations. Overall, the video appeared to instill a great amount of confidence among the test participants. Subjects were seen to gesture in agreement, to smile, and to laugh at various points in the video. It was as if the video provided a shift in concern, from anxiety about how to use the device to concerns about the content itself. Most participants viewed the video at least once through, and many watched the introductory portion a second time. On the whole, subjects who saw the video first appeared more determined – eyebrows knit, body leaning into the monitor – when moving onto the application itself, as compared with the control group.

Informal discussion with the subjects after the testing round confirms the value of the full-context video, and gives some insight into what matters. Most subjects agreed that by seeing the domestic helper in the video successfully finding a job through a computing application, they could also see how they or their friends could benefit from the application. A number of subjects told us that it was this element of the video that made them want to try the application at all. In fact, many of the subjects requested that we provide the application in their neighborhoods regularly.

They also understood where the information came from and how the jobs were entered into the computer, which previous subjects had not understood. More than one subject explained that they had never understood what computers were for, but that the video showed why people use them. The dramatized video immediately made this clear.

Overall, our subjects were so excited about the video that even after the tests, they continued discussing the particulars of the test application (for example, that the wages suggested by the employers in the video were inadequate). Some subjects were engaged enough to offer design recommendations, suggesting that there should be a way to contact the employers through the application so that they can negotiate their wages.

Finally, and perhaps the most interesting observation was that our subjects from Round 2 of the test, who had seen the video, were incredulous to find that our Round 1 subjects (often their friends and neighbors) had earlier been unable to complete the job-search task. They found it difficult to believe that anyone would not be able to understand the application.

VIII. Related Work

There are two areas of related work which are particularly relevant for our research. The first is in the usage of video for instructional material of various kinds. The second is the literature on user interfaces for non-literate users. To our knowledge, our work occurs at the unexplored intersection of these two streams, with some differences from existing research that distinguish this work.

A. *Video-Based Instruction*

There is a rich literature spanning decades, on the use of video-based instruction tutorials for effective learning. For our purposes, this literature can be categorized into three areas, as follows: (1) instructional video for learning specific non-computer-based skills or subjects, such as literacy, geometry, or physics; (2) anchored instruction which emphasizes applicability of the learned material; and (3) instructional video for the purposes of learning computer skills. We summarize the work in these categories, and interleave explanations of where our work fits.

The majority of the literature in video-based instruction falls in the first category – instructional video for the sake of learning a subject or a skill. There is existing work, for example, on learning geometry and physics. In one case for learning geometry, the well-known "The Adventures of Jasper Woodbury" problem-solving series – a tutorial series based on video instruction in which the central character is posed a variety of geometry-oriented problems in the real world – is examined and shown to expand student's ability to apply their geometry knowledge to real situations [[28]]. Similarly, and example with physics focuses on an interactive video tutorial as a way to enhance students' problem-solving ability in physics [[26]]. Two other articles discuss the advantage of video for learning skills, such as the reading and folding origami [[14], [25]]. The latter work incorporates a more sophisticated table-top set-up in addition. Perhaps the best explored cases of video-based instruction occurred during the peak of videodisc technology in the 1980s. The videodisc was the first widely available technology that allowed random access of video, and as such, researchers expounded on the value of customizable, interactive curricula using videodiscs [[8]]. Several books and articles have since been written, in which interactivity was shown to be superior to passive viewing of a linear video [[1]].

Our work inherits the lessons from this existing literature by using video for instructional purposes. It differs, however, in that the video content includes more than straightforward instructional material in which a subject or skill is the object of learning. In particular, we emphasize the need for greater context, and this brings us to the second category of video-based instructional research.

Second, in *anchored instruction*, the goal is to illustrate the context in which a particular subject might be relevant, so that the application of the subject matter is made clear to the student [[7]]. There is a wide range of literature specifically addressing anchored instruction, and most such articles argue for video and multimedia as a key component of anchored instruction, because the rich context of a given scenario is best portrayed in those media. For example, in another article on the "Jasper Woodbury" series, the authors argue that having specific characters that the viewer can identify with, and putting those characters into situations which require an understanding of the core material (geometry), helps to aid both attitude and recall of students [[1]].

The goal of full-context video, as presented in this paper, can be cast as a kind of anchored instruction, but there are subtle differences in intent. Specifically, while anchored instruction primarily poses subject-matter expertise as its end goal, our goal with full-context video is task-completion rather than learning, *per se*. We do, in fact, include instructional material that helps users navigate the UI, but the goal is not so much to make users computer literate as to make them computer *operational*: Computer literacy – if using a text-free UI can be called that – is a side effect. Also, whereas the explicit goal of anchored instruction is to help students understand how a subject is applied in the real world, the goal of full-context video goes one step beyond, to show users why they should be interested in using the computer in the first place.

Finally, there is a considerable amount of work on video-based instruction for learning computer skills. Most of this work is not in the academic research domain, but now fully commercialized, with entire firms devoted to producing such videos [[4], [5], [27]]. One group of researchers has considered the difficulty of post-hoc editing that is required to update video-based instructional material [[23]], and another has considered on-screen animations for learning computer skills [[22]]. One of our earlier prototypes followed in this vein of work (where over-the-shoulder shots of the screen were provided as instructions on manipulating the UI), but ultimately, it was not enough for our subjects without the full context. Again, the technical ability to manipulate the UI was not the dominant barrier to task completion for non-literate users.

B. User Interfaces for Non-Literate Users

The second stream of relevant work investigates user interfaces for non-literate users. This work is more recent and has a shallower history than video-based instruction. Early researchers in this area place emphasis on the need for contextual design methods to explore this problem, as non-literate users are very different from the target user imagined by most UI designers [[6]]. We follow this lead, and have spent literally hundreds of hours in the field, working with non-literate women.

Most previous work with non-literate users focuses on the mechanics of the UI. In particular, researchers immediately intuited the value of imagery in place of text, and extensive use of graphics is advocated by most of this work [[12], [13], [17], [19], [20]]. Among these, some also investigated on the value of voice annotations and instructions, which are of obvious value to non-literate users [[17], [19]]. Much of the interesting work in this area investigates the subtleties of graphics-intensive, audio-based UIs. Some authors note the plausible inclusion of number, as non-literate users are often numerate [[17], [19], [20], [21]]. Others focus on the need for ultra-simplified navigability as a design element [[12]].

While this previous work suggests excellent UI design elements for the non-literate user, none so far looks at removing the other barriers to using a computer in the first place. With full-context video, we address not only the immediate issues of illiteracy in using a computer, but also the lack of awareness, fear of technology, and deficiency in a cognitive model for the computer as an information store. Our work is thus novel in that it addresses these challenges directly for non-literate users.

In summary, while the use of video for instructional use is not at all technically new, our work takes existing work one step further, out of necessity for our target audience of non-literate users. Full-context video, not only provides anchored instruction, but also provides explanations of the value and working model of the computer in a way that is relevant to the non-literate user. This explanation is not strictly instructional in the sense of teaching a given subject or skill. Rather, it links a cognitive model of information flow with our users' desire for that information. To our knowledge, this is the first time such videos have been advocated for non-literate users, and the first time that context of this broad nature has been established to have value for first-time computer users, literate or otherwise.

IX. Conclusion and Future Work

We have presented the value of full-context video to aid first-time, non-literate users successfully navigate through a computer application with minimal assistance. In a previous user study, we had observed that in spite of our subjects' understanding of the mechanics of a text-free UI, they experienced barriers beyond illiteracy in actually interacting with the computer. In particular, there was lack of awareness of what the PC could deliver, fear and mistrust of the technology, and lack of comprehension about how information relevant to them was embedded in the PC.

In this paper, we proposed the use of full-context video to address these challenges by giving, the entire context of the application - including the scenario in which a user might use the application and a dramatization of how relevant information comes to be contained in the computer. In line with previous work with instructional video, full-context video also includes a tutorial of how to use the application.

In our experiments, conducted with 35 non-literate residents of Bangalore slums, the introduction of full-context video significantly improved the results of our usability tests. Dramatically, task completion for a conceptually simple job-search task was 100% with the use of the video, versus 6% for a subject sample without it. Results confirm that non-literate subjects can successfully interact meaningfully and independently with a computer application on their first contact with a computer, providing that the user interface and interaction design are appropriately designed.

There are a number of avenues of future work. In application, we are continuing to build on job search, working with an apartment complex with which our subject communities can interact via our application. We would also like to confirm the viability of text-free UI and full-context video for other domains. Two possibilities are to provide information about available government programs or relevant healthcare information, such as basic diagnostic information for common illnesses. Trials in these other domains should help to establish the value of full-context video more generally.

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TABLE II

USER TESTING RESULTS SHOWING NUMBER OF PROMPTS, TASK COMPLETION, AND COMPLETION TIME

Task: Get address	A:Text-based			B: Text-Free without full-context video			C: Text-Free with full-context video			Order in which tests were taken
	Task completed	Prompts reqd for completion	Completion time (min)	Task completed	Prompts reqd for completion	Completion time (min)	Task completed	Prompts reqd for completion	Completion time (min)	
Subject 1	No	18	-	No	10	-	Yes	6	7.2	A BC
Subject 2	No	19	-	No	11	-	Yes	8	8.5	A BC
Subject 3	No	5	-	No	8	-	Yes	7	9.4	A CB
Subject 4	No	16	-	Yes	5	10.5	Yes	4	5.2	A CB
Subject 5	Yes	7	3.6	Yes	7	9.4	Yes	3	3.2	A CB
Subject 6	No	18	-	No	12	-	Yes	5	7	A BC
Subject 7	No	4	-	No	15	-	Yes	9	11.3	A BC
Subject 8	No	-	-	No	12	-	Yes	8	10.4	A BC
Subject 9	No	19	-	Yes	8	10	Yes	5	4.6	A CB
Subject 10	No	21	-	No	15	-	Yes	7	8.2	A BC
Subject 11	No	18	-	No	12	-	Yes	3	4.5	A CB
Subject 12	No	6	-	No	9	-	Yes	5	9.2	A CB
Subject 13	No	-	-	No	11	-	Yes	2	3.4	A BC
Subject 14	No	5	-	No	16	-	Yes	4	7.2	A BC
Subject 15	No	8	-	No	13	-	Yes	7	12.3	A BC
Subject 16	No	7	-	Yes	11	8.2	Yes	2	3.1	A BC
Subject 17	No	20	-	No	18	-	Yes	6	10.5	A BC
Subject 18	No	15	-	No	10	-	Yes	5	8.6	A BC
Subject 19	No	12	-	No	9	-	Yes	6	8.5	A CB
Subject 20	No	17	-	No	7	-	Yes	4	7.3	A CB
Subject 21	No	-	-	No	8	-	Yes	4	6.4	A BC
Subject 22	No	11	-	No	8	-	Yes	6	9.5	A CB
Subject 23	Yes	4	1.5	No	7	-	Yes	3	4.3	A CB
Subject 24	No	10	-	No	6	-	Yes	5	7.5	A BC
Subject 25	No	12	-	No	11	-	Yes	6	9.2	A BC
Subject 26	No	18	-	No	13	-	Yes	7	10.4	A BC
Subject 27	No	19	-	Yes	5	4	Yes	3	3.5	A CB
Subject 28	No	5	-	No	9	-	Yes	4	4.6	A CB
Subject 29	No	-	-	Yes	6	6.1	Yes	3	5.4	A CB
Subject 30	No	15	-	No	14	-	Yes	10	14.5	A BC
Subject 31	No	4	-	No	11	-	Yes	9	13.7	A CB
Subject 32	No	13	-	Yes	4	13.4	Yes	5	7.5	A CB
Subject 33	No	11	-	Yes	7	10.5	Yes	5	4.2	A CB
Subject 34	No	7	-	No	9	-	Yes	4	6.5	A CB
Subject 35	No	5	-	No	7	-	Yes	5	6	A CB
Average	5%	10.5		20%	9.8	9.01	100%	5.2	7.5	