

Issues in the User Interface Design of a Content Rich Vocational Training Application for Digitally Illiterate Users

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Abstract—This paper discusses our preliminary experiences in the design of a user interface of a computerized content-rich vocational training courseware meant for users with little or no computer experience. In targeting a growing population with limited access to skills training of any sort, we faced numerous challenges, including language and cultural differences, resource limits, gender boundaries and, in many cases, the simple lack of trainee motivation. With the size of the unskilled population increasing much more rapidly than the numbers of sufficiently skilled teachers, there is little choice but to develop teaching techniques that will take advantage of emerging computer-based training technologies. However, in striving to serve populations with minimal computer literacy, one must carefully design the user interface to accommodate their cultural, social, educational, motivational and other differences. Our work, which uses computer based and haptic simulation technologies to deliver training to these populations, has provided some useful insights on potential user interface design approaches.

Keywords—User interface design, digitally illiterate, vocational training, navigation issues, computer human interaction, human factors.

I. INTRODUCTION

VOCATIONAL education and training (VET) holds the potential to remedy the plummeting rate of workforce participation of unemployed population in the country, but the conventional training system has been increasingly unsuccessful in attempting to reach the rural and tribal areas where the majority of the economically marginalized populations reside [1]. India's labor force is in fact dominated by the informal labor sector—characterized by low skilled jobs offering in return, inadequate pay [2]. Vocational education has therefore become critical in addressing the socio-economic development of the impoverished masses as it delivers results quickly, allowing for the trainee to begin earning income in the matter of months [3]. It is within such a context, that computer based training applications has been developed to assist delivery to the rural masses in India [4].

Because of low literacy levels and non-exposure of the population to the cultural mainstream, designing a user interface that the users can understand and relate to is challenging on many levels. Another challenge is the intimidation factor when it comes to users using technology

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for the first time. We have observed, as cited in previous studies [5], that if there is not clear guidance in the process of using the application, the user feels that they may “break something” and fail to return to their place in the application.



Fig. 1 Women taking a computerized VET course on fabric painting offered by Ammachi Labs in Kerala, India

Much work has been done in UI design for low-literacy communities, such as Medhi et al.'s work with text free UIs and icon styles [6], and visual representation [7] and Heunerfauth et al.'s study of role of audio roll over on clickable elements and design recommendations for digitally illiterate users [8]. We have verily adopted much of the design elements for our application from such prior work. Several applications have been developed targeting low-literacy users especially in India, including financial management systems [9], designing digital games for rural children [10], a story bank for rural communities [11] and mobile applications [12]. Limited work has been done for content rich educational courseware for the target population. The Sakshat Amrita Vocational Education (SAVE) project of AMMACHI Labs has developed desktop and m-learning based computerized vocational training courses that bring education to rural India utilizing an online portal, or alternatively, offline multi-modal software applications that deliver education and skill training using video lectures, game based learning and haptic simulators [13], [14]. This program offers a solution that helps overcome the obstacles of scalability, limited trainers, poor infrastructure, training tools and material cost and the lack of incentive to study.

In this paper we discuss the fundamental issues in user interface design that need to be addressed in order to create an experience for the illiterate or semi-literate user. It will have to be engaging and offer a low intimidation factor, and needs to be transparent and not be an obstacle for learning the content presented to them by the application. We further study how low-literacy users comprehend and respond to representations in the form of icons, buttons and other graphic elements such as tabs and relationships between pages and elements that influence navigation.

II. USER INTERFACE DESIGN

In creating software to provide vocational education to low literacy users, we faced issues that were challenging, yet informative and educational, to overcome. The application utilizes a multi-modal approach, containing video lectures, interactive workbooks, & workshops in one intuitive and seamlessly integrated application by approach organizing video lectures, interactive workbooks and quizzes within virtual chapters. The interactive workbooks offer different scenarios, allowing the student to learn procedural vocational knowledge in an interactive manner [4]. For fabric painting, the workbooks include those made for digital painting, design arrangement, composition & coloring [13]. Like any other book or e-learning application, our application has a glossary. What sets it apart from other similar endeavors is the fact that the user can interact with it. Glossaries are generally not an exciting place to visit, but with an interactive 3D glossary, where for instance, you can tumble around pumps and pipes and explode faucets, the users find themselves looking forward to looking up an unfamiliar term.

Each glossary item has a definition in the form of a 3D model with a textual and audio caption. The user can drag the model around with the mouse and view it from all angles, and in the case of complicated materials, for instance, a compression faucet, the model will “explode” and reveal all of the parts individually and show how they fit together. The application gets the users comfortable with dabbling with the subject using different modalities, slowly adding complexity layer by layer.

The interaction is designed to provide progressive disclosure; First in navigating the classroom with the least amount of mouse clicks, then through the workbooks that add one more level of complexity in terms of drag and drop, then the 3D glossary that allows 3D manipulation and finally the hands-on interactive haptic simulation environments.

A. Application Features

In the early stages of development, we had anticipated certain obvious challenges to creating an interface that illiterate or semi illiterate users could feel comfortable to navigate. The features described below were included in the first version of our software application’s user interface.

1. Graphical Login

The first thing the user has to do is to log in to the software application, required to track individual progress, as shown in

Fig. 2. This creates an immediate and obvious issue with using an English language keyboard for low literacy users.



Fig. 2 The graphical login screen showing the pictures of the users used as their username in the VET application

So we incorporated a graphical log in and password process. The picture of the user is established as the “username” for the student. The users’ first task is to choose a picture of their choice from the selection pool of images, used as their graphical password. A simple personalization such as this also helps build a sense of comfort, simplicity and ownership towards the course in the user.

2. Mouse Tutorials

The mouse tutorial is a 2D animation that shows the relation between the mouse movement and the cursor on the screen, and highlights which fingers should click the left button and for what purpose.



Fig. 3 Screenshot of the mouse tutorial game for teaching use of mouse clicks and drag drop

The next step is to play a simple “pin the tail on the donkey” type of flash game with an elephant instead to contextualize to the Indian setting, shown in Fig. 3, that is developed to help the user to get practice in using the mouse to navigate the screen, and to get a hang of the relatively more advanced skill of dragging and dropping objects in specific locations.

3. Skeuomorphic Representation

The main UI of the application was designed to look like an open book as shown in Fig. 4. We hypothesized that our target users would be familiar with a book and understand the hierarchies of using chapters and subchapters for navigating through the content.



Fig. 4 Chapter selection page showing the skeuomorphic chalkboard and open book design

For icons, skeuomorphism was introduced using semi-abstracted graphic elements, partly adopted from Medhi et al.'s work [6] as real-world references to things the user would instantly understand, like an open door with an arrow pointing through it for the application exit button and a chalkboard icon to represent the button to navigate to the classroom.

B. Experimental Setup

The user interface for our first version of the fabric-painting application was subjected to an initial usability test, with a specific focus on observing comprehending icons and navigation, and the users' responses to representations and relationships.

1. Subjects

15 women who were enrolled in for the fabric-painting course for this study were selected for this study. Their ages ranged from 22 to 39 years with a mean age of 32.7 years. All of them were neo-literate or semi-literate, and none of them had a school education above 8th grade. Eight of the women had never before used a computer in their lives and the other seven had used a computer less than ten times in their life and over two years ago.

2. Training

In a course, users typically receive training on computers for two hours a day, followed by exposure to actual materials with a live skilled trainer for one hour. For many, the major motivation for the users to enroll for this course is that completion of the fabric-painting course earns them the government granted Artisan's Card that provides access to selling their products in government run handicrafts exhibitions and several monetary subsidies.

3. Testing

The training sessions were videotaped and screen capture videos of the application in use were collected. The aim of this study was to understand how the target population interacted with the basic functionalities of the application, graphic user interface and training modality. After five days of training, user feedback was collected through survey interviews consisting of 17 close-ended questions using a SUMI style questionnaire.

4. Results

Fig. 5 shows six questions answered by the usability test users from the questionnaire that suggested some unexpected findings.

The questions elicit a yes or no response and are as below:

- i. Learning to operate this software initially is full of problems.
- ii. I have to look for assistance many times when I use this software.
- iii. I have to be fluent in reading to use this software.
- iv. It is easy to forget the steps required to access different parts of the software.
- v. I would prefer to have a teacher be teaching this course when compared to the computer.
- vi. I am enjoying the sessions with this software.

As seen in the plot, seven of fifteen women seemed to think the application was difficult to use in the initial stages. Lack of language fluency was not reported as an obstacle to using the application. The major source of concern noticed in the videotapes as well as in the survey, was trouble with navigation and a lack of clear understanding of the structure of the course. All the above mentioned issues still did not hamper their enthusiasm with the course, suggested by a positive response to the training sessions and a preference of learning on the application to a teacher, as the users seemed to feel they could revisit the portions they did not comprehend well or learn in a self-paced manner which would not have been always possible with a teacher.

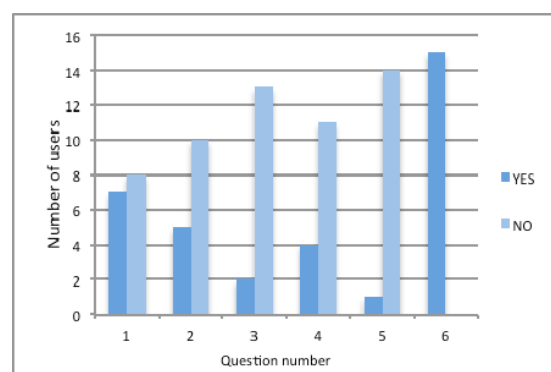


Fig. 5 Plot showing number of users' answers to the survey questions of the initial usability test

5. Discussion

The user feedback from this study made us question the efficacy of our UI that was designed keeping in mind the

principles generally outlined for the design of user interfaces for semi-literate and digitally illiterate rural populations [8].

a. Relationships: Hierarchical Structures: A challenge that the users faced was in understanding the hierarchical structure of the content framework viz. chapter, subchapters etc. Studies show that education cultivates the habit of building and understanding hierarchical structures, and that educated people are effective in using “Memory of Serial Order” during computer usage, and that low literacy people are not as effective in this [15]. We found that even when the correct order in which to study the content was explained to all of the students in the orientation, not all of the students followed it, and many started on later chapters. All the activities within one subchapter need to be completed before moving on to the next subchapter. We noticed in the videotapes that some students would go straight to the interactive games, skimming over the classroom content.

We also observed that if a user failed to understand the concept of an activity, most of them would attempt to skip that activity and move on to the next one. Instead of utilizing the help section for that activity or being motivated to press through it. This is when we seriously started to consider the need to build a guided UI system that would restrict navigating ahead of something that wasn't completed already, so that the student gets the full benefit of the content being supplied to them.

b. Representation: Icons: Most users did not seem comfortable with the icons available for them to choose. It did not seem to matter so much what the icon looks like, what seemed to matter more is where the icon is placed within the screen and at what point it becomes available for the user to click. Icons located at the bottom bar of the UI were widely underutilized, and when utilized, usually was not in the correct context.

c. Navigation buttons and Workable Area: There exists a general back button but there was reluctance to click it and users seem to struggle a lot before remembering that it was the way out.



Fig. 6 Screenshot of the old UI video lecture screen showing the background graphics that created confusion for the users

This was especially noticeable when the user was watching a classroom video or playing the interactive workbook when it

was at full screen. Even though the controls are toggled there in the bottom of the screen to move from full screen, back into the screen that fits in the main UI, many users hesitate at this point on how to get backward. It occurred to us that the entire UI disappearing behind the maximized video was confusing for users, since they were then outside of their familiar context “workable area”. Many of our observations pointed to the fact that users don't like to click buttons unless they are absolutely sure what they do and where they will take them. Also, upon opening up the application for the first time, many users try to click on some background graphics that we had, located in the middle of the screen. For each course we had some background graphics that related to the theme of the particular course, for instance, for plumbing UI graphics, we have some images of nuts and bolts strewn about in the main screen as behind the major UI elements as shown in Fig. 6. From that we concluded that even though there is probably some amount of fear for them in clicking, there is less fear for them to click within the middle of the screen then on the bottom or top.

III. RAPID PROTOTYPE UI

In order to find a solution, we chose to focus on the most critical areas of concern, and to make a prototype with some possible solutions for testing purposes. It was imperative to eliminate as much of the navigation as possible, and to design a model that guides the user through the UI, instead of expecting the user to follow the same pattern that people with normal cognitive thinking systems use. To do this, we created a guided interface that walks the user through the entire process, eliminating about 80 percent of the navigational icons. We completely eliminated the bottom navigation bar, and placed the requisite icons into the working area of the application. Progressive disclosure of information was incorporated to guide the user through the course content, by only making available the content that they are required to study next. To achieve this, a green glow highlight was added around the icon of the element that is next to be engaged by the user. All other icons were given a very low alpha, and were unavailable for clicking. We eliminated the physical textual tree structure that was in the original UI and replaced it with using the metaphor of a book and different pages within that book. For this stage, we retained the chapter/subchapter structure, but made each of these on different pages of the metaphorical book. To address the concern of the user exhibiting fear after having maximized a video lecture to full screen, we have redesigned the video and game screens to appear as a light box, over the UI screen that the user is currently on.

A. The Apple Pie Test

With the new features of progressive disclosure, icon/choice reduction and light box pop up content, we conducted a test with the new prototype, using a dummy content course on how to bake an apple pie. In this Apple Pie UI test our main objective was to see if the users would be able to naturally take the intended route of navigation through the UI, for optimal content consumption.

The test involved 11 participants all female and ages ranging between 19 to 40 year and an average of 29 years. Only four of the eleven participants had ever used a computer before and that too sparingly and not within the last one year.



Fig. 7 A participant, a first time computer user trying out the apple pie user interface



Fig. 8 Green glowing clickable button on the apple pie application suggests the next navigational step

All the participants had basic literacy skills having completed their 10th grade education. It needs emphasis that the apple pie test application is designed such that it does not require the use of a keyboard at all. Hence we covered up the keyboard with a piece of cloth, as seen in Fig. 7, to create a more simplified and less intimidating experience for the novice users. A passive observer sitting behind the user took down observations. Pre-test and post-test surveys were also administered.

The results of the test were widely successful in proving our concept. The participants were able to successfully navigate through the prototype in the intended order, without much outside prompting. According to our surveys and observations, the new feature that proved to be the most useful in aiding this was the green flashing box around the next available option, as shown around the clickable icon in the screenshot of the application in Fig. 8. All users stated that this was a guidepost for them and was easy to follow. Through the reduction of icons and simplifying of UI graphics, we were still unable to troubleshoot the issue of users perception of the representation of icons. We only then kept three icons on the bottom of the

screen: Exit, Help, and Back. The buttons were made large and the graphics were still using realism in design. We observed that despite our efforts, the users were unwilling to click any icons located outside of the frame of the book. In this way, the icons of Exit, Help and Back remain largely untouched by the users.

IV. CONCLUSION AND DESIGN RECOMMENDATIONS

We propose a concise list of recommendations for designing UIs for e-learning/training software that should be viewed as an extension to the standard recommendations set out by other research groups on this topic.

- We reiterate previous findings that any graphics that do not serve a practical purpose in the UI should be eliminated.
- Graphics for aesthetic purposes should be used with caution.
- Main navigational icons and elements should be kept in the working area of the screen, as opposed to the corners or header/footer areas.
- Icons such as Exit, which the designer would like the user to avoid, or use less, can remain in the top or bottom of the screen.
- Simplify hierarchical structures as much as possible, and if it cannot be eliminated, create a metaphor, like suggested by Medhi et al. [4], that the user will not be subject to have to navigate through an outline, but will be able to be in the illusion that they are moving forward within the application.

V. FUTURE WORK

Based off of both the usability test and the Apple Pie UI test, we have built a new iteration of UI, incorporating all of the features that we added to the test prototype. For the new iteration, we will move any navigation elements that are needed into the inside of the book background graphic, essentially what we call the “workable area.”

For low-literacy users we conclude that it is not that necessary to keep the Exit button as a prominent feature of the application. Further work needs to be committed to the area of large volume information carrying applications for low-literacy users.

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