

Virtual Media Enhanced Vocational Education Curriculum

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Abstract—The following paper discusses the development of a virtual media enhanced vocational education curriculum that ultimately aims to reduce the digital and economic divide by targeting the illiterate and neo-literate sectors of India. While the application utilizes enhanced graphics, the end user experiences a simplistic interface. The virtual environment is developed in a modular way, enabling the user to learn methodically and at their own pace. The application's key usability element is that the fully developed virtual media enhanced vocational education curriculum will be web-based, where the user can access the program from any location through the medium of a computer and internet. Such an application has the potential to impart effective vocational training to the masses and at a pace that is at the comfort and pace of individual users. While the following paper discusses a specific application developed to train plumbers, the concept is generic and can be extended to any vocational training.

Keywords-Virtual Curriculum, Media Enhanced Education, Vocational Training, Plumbing, Simulation, Human Computer Interactions, ICT for Education

I. INTRODUCTION

Viable employment opportunities in India remain out of reach for an alarming percentage of the population, as over 28 percent of the country (or approximately 330 million people) lives below the poverty line (CIA World Fact Book, 2007). Given the direct relationship between education and employment, startling poverty levels in India can be attributed to the fact that only a small fraction (11 percent) advance from the secondary (high school) to tertiary (vocational trade school, college, post-graduate) level of education (UNESCO Stats). Yet another indication of the apparent barriers to education and employment attainment in India: nearly 40 percent of the population is illiterate

(World Bank, 2007). This novel educational prototype developed by Sakshat Amrita Vocational Education (SAVE) is a virtual media enhanced curriculum that intends to address these challenges. The SAVE model enables those with even limited education and financial resources to gain easy access to a vocational education that will enhance their employability. While the following paper discusses the development of a virtual media enhanced vocational education curriculum that trains individuals in the vocation of plumbing, the concept is generic and can be extended to any vocational training.

Plumbing is the skilled trade of working with pipes, tubing and plumbing fixtures for water and waste management systems. Due to the universal need for clean water and waste management, plumbing as an occupation is in high demand. However, given the high costs associated with training and certification, a large percentage of potential plumbers are unable to take advantage of this demand within the formal labor sector [3]. According to the Industrial Training Institute (ITI) of India, standard plumbing courses require a minimum of two years to complete, and costs on average approximately Rs. 50,000 [4]. This investment is beyond the means of a majority of individuals seeking better employment opportunities, where more than 40 percent of the country struggles to live on \$1.25 a day [1]. Upon completion of a certified plumbing course, a graduate can expect to earn between approximately Rs. 200 to 300 a day [4]. SAVE intends to provide vocational courses that eliminate the barriers of cost, accessibility and prior experience, while also raising the current standards of education.

While the application utilizes enhanced graphics and virtual environment technology, the end user experiences a simple interface specifically designed to train those with limited academic abilities.

A. Interactive Learning

According to *Interactive Multimodal Learning Environments* [5], learning is enhanced through multiple representations of material. The SAVE model accordingly adopts a multimodal learning approach, in which the user learns through verbal and non-verbal (audio, visual and textual) representations of the material.

A review of literature regarding learning methods demonstrated the utility of interactive

learning. Interactivity provides a multidirectional learning environment where the learner interacts with the teaching device, further enhancing the learning process [5]. A study on the efficacy of simulated learning environments upon medical students revealed that students were better able to grasp the actual operations entailed within the medical procedures through the interactive medium as compared to traditional textbook learning [6].

With regard to the vocation at hand, plumbing, resources such as The International Association of Plumbing and Mechanical Officials Uniform Plumbing Code (IAPMO UPC) Illustrated Training Manual are available to serve as a simple step-by-step guide to learning the vocation of plumbing [7]. However, such one-dimensional educational tools fail to provide an element of multimodal interactivity, found to be especially useful when educating those with limited academic abilities.

Through the development of an interactive multimedia textbook for an engineering course at the University of Victoria, Canada, Kher Hui Ng and Ryoichi Komiya identified the advantages interactive multimedia textbooks have over standard textbooks [8]. 15 undergraduate students and university staff were selected at random to test and assess the efficacy of the multimedia textbook. The following advantages of the multimedia textbook were determined:

- Average learning time was reduced
- Heightened interest in the subject matter
- Better understanding of subject matter
- The multimedia textbook better accommodated varied learning styles.

The SAVE model, in turn, encompasses elements of the interactive multimodal learning approach through the incorporation of multimodal interactive features. As depicted in Figure 1, the application is structured modularly, such that the user is able learn methodically and at their own pace. The application is comprised of four components contained within chapters of the course: classrooms, interactive workbooks, virtual workshops that simulate practical hands on learning, and an evaluation module where the user can self-evaluate their own progress.

The key usability aspect of the entire application is that the fully developed curriculum will be entirely web-based where anyone can easily access vocational training courses.

II. COURSE COMPONENTS

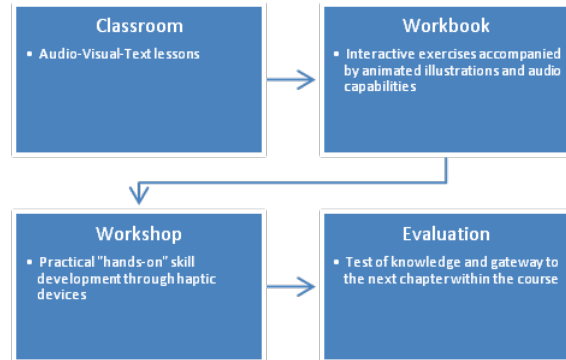


Figure 1 SAVE Course Structure

Each vocational course consists of the following components contained within chapters of the course: classroom, workbook, virtual workshop and evaluation module.

A. Classroom

The classroom serves as the stage for theoretical learning of the occupation. Each classroom contains multimedia content: videos displaying demonstrations accompanied by animations, images, and text. The text (which is currently available in Malayalam and English, with a plan to extend to all major Indian languages) changes according to the current demonstration being carried out in the video.

B. Workbook

Workbooks provide a simulated interactive environment where the user gains practice on tasks and operations specific to the occupation. In accordance with the entire application, auditory and visual instructions are provided to guide the user. The user is prompted accordingly when the procedure is correct or incorrect.

Each workbook has three sections

1. Objective: describes the objective of each workbook.
2. Methodology: describes the steps involved in completing the workbook, accompanied by audio-visual animations and text describing the animation.
3. Workshop: an interactive element, utilizes materials, tools and fittings accessed from their respective menus. When the user clicks on any of these menus, each one opens up revealing its contents. The user can drag an item from the menu textual messages are made available.

C. Virtual workshop

A virtual workshop is generated through the medium of touch sensitive haptic devices such as the Novint Falcon, which provides touch and force

feedback to the learner simulating practical hands on learning. Here, a real time experience of working with the tools is gained. For example, the user can actually see a rough piece of wood being smoothed in real time.

D. Evaluation Module

The evaluation module enables the user to self-evaluate their own progress through a series of multiple choice questions.

III. USABILITY

As SAVE's target audience consists of learners with basic education, the application has an easy to use interface. As seen in Figure 2, the welcome screen prompts the user to identify themselves through a pictorial user name and password.



Figure 2 User Log In and Password Screen

In order to familiarize users with computers, interactive instructions on how to use the mouse and haptic device are provided (Figure 3). Haptic technology, through its built-in tactile sensation and forced feedback capabilities, provide the user with a virtual environment that simulates real-world applications.



Figure 3 Mouse Tutorial

A game is incorporated in the tutorial to enhance the user's ability on the use of the computer, and also adds an element of fun to learning. While, the current application offers the course in two languages: Malayalam (native to the state of Kerala, India) and English (an officially recognized language in India), courses will be available in every major Indian language so that users all over India can easily access the curriculum. The application also allows the user to easily migrate to any available vernacular language within the application as well as choose and switch between languages.

IV. METHODS

This section provides a brief description of the software's and technologies used in the development of the SAVE model. The following tools were utilized to design and implement the functionality of the media-enhanced curriculum. Flex builder (which uses MXML to define its components) was chosen based on its ability to serve as an Integrated Development Environment (IDE) with visual layout, debugging, skinning, coder hinting and styling useful in the development of Internet and desktop applications.

A. Software Tools

1. Adobe FlexBulder3

Flex [9] is a free, open source framework for building highly interactive, expressive web applications that deploy consistently on all major browsers, desktops, and operating systems. It provides a modern, standards-based language and programming model that supports common design patterns. MXML offers a way to build and lay out graphic user interfaces. Interactivity is achieved through the use of ActionScript.

2. MXML

MXML is a XML-based user interface markup language first introduced by Macromedia. MXML is used mainly to declaratively lay out the interface of applications, and can also be used to implement business logic and internet application behaviours. MXML is also used define nonvisual aspects of an application, such as access to server-side data sources and data bindings between user-interface components and data sources. Adobe's Flex Builder IDE and free Flex SDK generate SWF files from MXML.

3. XML

Extensible markup language (XML) and Unicode was utilized to author the contents. Unicode helps to encode text in various languages. The display of

which consists of selecting a particular font under the operating system. Extensible markup language is used to specify the chapters of a vocation trade. Various sub-topics of a chapter are in turn specified in another xml file. Each classroom video link and the text that appears according to cue-points that represent elapsed time within a video are in turn embodied in another xml file. Questions for tests are in turn described in an XML file which consists of multiple choice questions and answers. Flex reads XML data natively without need for any parser to be implemented. All content surrounded by tags called elements and attributes of them are accessible to flex as native data types. Flex is also used to change the language of the text based on the user's option of the language.

4. Actionscripts

ActionScript3, a powerful object-oriented programming language, is used to create client logic. Flex also includes a rich component library with more than 100 proven, extensible UI components for creating rich Internet applications (RIAs), as well as an interactive Flex application debugger. ActionScript is a scripting language based on ECMA Script. ActionScript is used extensively for website development, database applications, robotics.

5. X3D

Extensible 3-D Graphics is a variant of XML used to declaratively specify the graphics displayed on the screen.

6. H3D

Haptic 3-D Graphics is another variant of XML that is used to express interactive force-feedback properties of the graphic object. Utilizing the hardware of pre-existing haptic devices frequently found within the digital gaming industry, such as the Novint Falcon, SAVE is re-engineering the software of devices for the purposes of guiding students in their respective vocation (such as plumbing).

7. H3D API

Haptic 3-D Application Programming Interface [10] abstracts the interfaces to the Novint Falcon and integrates the above stated XML variants. New haptic and/or graphic effects can be created using C++ programming language. Python can also be utilized to generate quick prototypes and wire the effects to the objects.

B. Hardware Tools

1. Touch Sensitive Haptic Device

Interactivity of objects in the 3D world is done through novint falcon device. The Novint Falcon is a haptic device that has the ability to move in three dimensions. The movement of the device is mapped to the objects involved in the task. Force feedback can be provided by the haptic device. The Novint Falcon is utilized in the functionality of the workshop. For example, the Falcon simulates for the user, how a drill feels when used on different materials such as wood, concrete and metal.

V. RESULTS

Common to each interface, is a series of icons that provides the user with an option for help, program exit, and return to the chapter index. As depicted in figure 4 the standard view of each classroom consists of a text box and video screen.

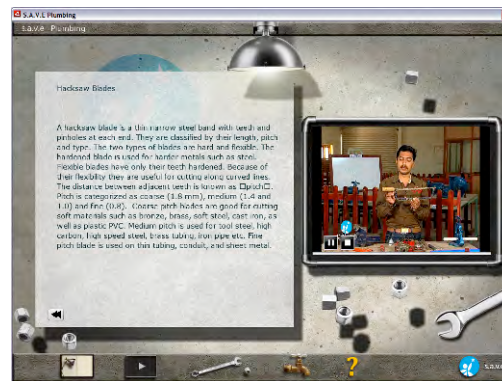


Figure 4 Classroom

The video window can expand to full screen mode (Figure 5).



Figure 5 Video screen expanded to full view.

The workbook familiarizes the user with the different type of blades used with the hacksaw frame. The type of blade used varies according to the type of material being cut. The user first goes to the materials

box to drag and fix the pipe in the pipe vice (Figure 6).

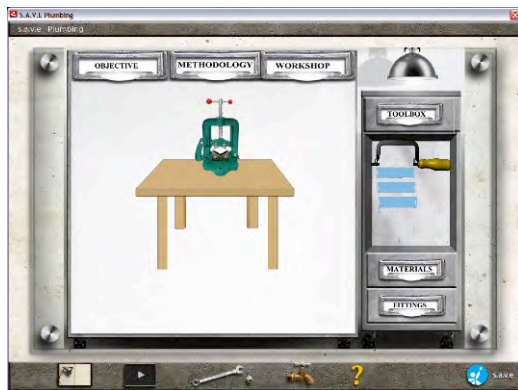


Figure 6 Interactive Workbook

Then, the user is directed to the tools box where they drag the hacksaw frame and choose among three blades to cut the pipe. If the correct blade is chosen, the hacksaw with the correctly chosen blade will allow the user to cut the pipe.

The evaluation interface consists of a list of multiple-choice questions, accompanied by audio when the user rolls over each option to accommodate users with basic literacy skills. A navigation menu is provided within the interface that allows the user to move from one question to the next.

VI. FUTURE WORK

Given the depth of the plumbing curriculum, SAVE aims to develop and deploy the course over 5 modules, as articulated by the Directorate General of Employment and Training Ministry of Labor and Employment. While the course is currently available in Malayalam and English, language options are to be extended to all major Indian languages. Deployment of the media enhanced plumbing vocational curriculum will provide usability feedback, which will further illuminate and evaluate the learning process.

VII. CONCLUSION

This paper discussed the development of a virtual media enhanced vocational education curriculum that ultimately aims to reduce the digital and economic divide by targeting the illiterate and neo-literate sectors of India. In order to better cater to the target audience, SAVE adopts a multimodal interactive learning approach that is structured modularly so that the user can learn effectively in simple and progressive steps.

Given the obstacles that prevent many from participating freely in the education or employment

industries, the starkest distinguishing feature of the SAVE application is that the fully developed curriculum will be entirely web-based where anyone can easily access vocational training courses using any browser at any workstation. This method of learning lends itself towards scalable deployment where multitudes of people --illiterate, neo-literate, and those with basic education can gain access to a standardized vocational education at low cost.

ACKNOWLEDGEMENT

We would like to acknowledge our Vice Chancellor Dr. Venkatrangan, for supporting and giving us an opportunity for developing this Application. We would like to thank Ministry of Human Resource Department (MHRD) for supporting this work. We would also like to acknowledge Rohan.S, Tony Natesan, Anoop. A, Leo John Thomas, for their contributions.

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