The Development of an Online Engineering Alphabet

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Abstract - Engineering is an unknown profession to many children, as current research proves that almost all of Pre-K, Kindergarten, and first grade students do not understand the scope of engineering concepts. In this study, the authors developed a WebCT-based tool to teach the US Alphabet using engineering pictures and animations. Currently, each letter is illustrated with sample pictures and animations starting with that letter. In addition to the alphabet-teaching module, this tool also has a number of oral and virtual quizzes. Sections describing famous engineers, different engineering majors, and an engineering glossary are also part of the current development as well. The first phase of this development was beta-tested in local public schools during the summer of 2003. Students and teachers responded that the tool was very effective as an instructional source web-book for introducing the field of engineering to young children. In this paper, the authors report current development and the results of the beta testing.

Index Terms – Engineering Alphabet, K12, Online, WebCT

INTRODUCTION

The United States faces serious problems in science, engineering, mathematics, and technology education, including: lower science and math test scores of US high schools students with respect to the rest the industrial world; declining enrolments in engineering programs; technological illiteracy; and a higher turnover rate of secondary school students with respect to the rest the industrial world; technological illiteracy; and a higher turnover rate of secondary school science and math teachers. The number of women and minority students in engineering are not representative of the general population – less than 20% of engineering graduates are women while over 50% of college graduates are women [1]. Perhaps the most serious and amendable cause of this problem is that many students leave high school with no real understanding of engineering and technology; yet most jobs today require some level of technological literacy. Even a decade or so after many engineering institutions established outreach programs for bright high school students, there has not been a significant increase in engineers in training. Less than 15 percent of high school graduates have enough math and science to pursue scientific/technical degrees in college, and almost half who begin engineering courses drop out in the first year. Less than 2 percent of U.S. high school graduates go on to earn engineering degrees, and five years after graduation, 80 percent of those graduates are working in some other field [2]. As a result, engineering schools should develop effective tools to attract and retain students. One way to develop more candidates is to develop a better selection pool before students arrive on campus. Thus, the researchers began this project under the assumption that if students at the elementary school level are made aware of engineering fields, they will be motivated to pursue the science and math they need to succeed in engineering programs.

Additionally, although a large number of web-based instructional modules have been developed for high school and middle school students to introduce them to various engineering fields, no development has been presented to explain the basics of engineering to five to eight-year old children.

McKenna and Aggogino [3] developed and implemented a web-based instructional module for teaching middle school students principles of engineering design using some simple machines. This Java-based module is intended to introduce students to the practice of engineering and specifically to have the students design and learn while working with simple machines.

Bransford [4] has developed some innovative, instructional materials to introduce science and mathematics into elementary and secondary schools. The Learning Sciences Institute K12 Learning Consortium develops information technology materials to assist teachers of elementary and secondary science and math.

In this project, the authors have used WebCT (Web Course Tools) to create a combination of various modules for five to eight year old children to teach them about different engineering fields and their applications. The reason for using WebCT is to utilize its various development tools (i.e. quiz, calendar, dictionary, search) and password protected access. The online engineering alphabet tool was developed in late summer 2003, and was beta tested during the fall 2003 semester. Beta testing has been performed in public elementary schools in Putnam County, Tennessee. Pre-K, Kindergarten, and first grade students have practiced with the teaching modules, dictionary, and quiz tools. Some teachers also received an access code to test this development in their...
classrooms; reports about some problems they faced were then given to the authors.

This current paper will describe the development of an online engineering alphabet within a WebCT application. The various modules of the development will be discussed briefly, along with the beta testing results collected in late 2003.

**WHAT IS WEBCT?**

WebCT [5], developed at the University of British Columbia, Canada, is an online course management system for developing and delivering web-based educational activities and materials. If students have access to the web using a PC workstation or a laptop, then instructors can include WebCT-based activities that support the course activities (i.e. tests, discussion, lecture materials, and sample solutions). Also, some of the related course work can be submitted and controlled via WebCT (i.e. homework, lab reports, and team projects).

**ENGINEERING ALPHABET**

The Engineering Alphabet for Elementary Schools was developed by the authors in late summer 2003. WebCT has been used since it has many valuable tools for such a versatile application. Figure 1 shows the layout of current development. This tool currently has the following links:

- Agenda
- Engineering Glossary
- Letters
- What is engineering?
- Famous Engineers
- Numbers
- Quizzes
- The ASEE Engineering K12 Center
- Institute

**Agenda**

This section holds a calendar of events, which is used to announce upcoming scheduled learning activities and events. It is beneficial for students and parents to learn about the upcoming activities so they can prepare for the tasks. By informing students and parents of upcoming events, they can successfully complete the activities and effectively learn the presented engineering concepts. The calendar also contains “private” entries by means of which the user, the parent or child, can make comments, reminders, etc. regarding the task.

**Engineering Glossary**

The engineering glossary has an easily accessible interface for navigating through the alphabet. All 26 letters are described and hyperlinked to their teaching site. The glossary is used to gather brief and quick information for the students. The glossary gives an alternative to using the Letters section.

Figure 2 shows a sample search from the Engineering Glossary.

![Figure 1: WebCT Based Engineering Alphabet Tool](image1)

![Figure 2: Sample Search in Engineering Glossary](image2)

**Letters**

The Letters section has an interface through which students and teachers can navigate through the different letters. Many engineering pictures and animations are used to describe the English Alphabet letters in this section.

When students access each letter, they find many visual pictures/animations to support their learning and practice. Figure 3 shows a sample link from letter J.
FIGURE 3:
LETTERS LINK HAS A NUMBER OF VISUAL SUPPORT MATERIALS TO TEACH THE LETTERS WITH ENGINEERING TERMS

What is engineering?

Different engineering fields are briefly described with some animations and avi video files. This site gives some access to various engineering society’s websites. Without reading the information in the text, students can learn something about the tasks, tools, and practitioners of engineering through the visual images. Figure 4 shows the links from Mechanical Engineering and Manufacturing Engineering.

FIGURE 4:
LINKS FOR ENGINEERING FIELDS

Famous Engineers

Throughout history there have been engineers, many of whom we still recognize today. The Famous Engineers link provides short biographies of many historical and present day engineers. Through the ASEE site for well-known engineers in politics, education, and managements, students will be able to learn about engineers, their accomplishments, and their contribution to society. Figure 5 shows a sample link from the 39th president of the United States, Jimmy Carter.

FIGURE 5:
FAMOUS ENGINEERS IN POLITICS, SCIENCE, EDUCATION AND MANagements

Numbers

Since engineers deal extensively with mathematics, the course contains a section in which basic numbers are taught. Each number is defined with sample symbols. Figure 6 is a sample view from this site.

FIGURE 6:
SITE LINK FOR THE NUMBERS

Quizzes

There are a number of quizzes in the course to verify student learning. Figure 7 shows the links for two quizzes. These quizzes contain test items with pictures, voice recordings, and animations in which the students are asked to identify letters of the alphabet with tasks and items related to engineering. By means of voice cues and instructions, students who do not yet know how to read are able to relate object/task to its name and the letter of that name. Furthermore, in many of the quiz items, the unfamiliar item/task is verbally named as well as visually represented and the letter of the alphabet is pronounced.
A sample quiz appears in Figure 8. In quiz item 4, when the student clicks on the hyperlink, familiar to all pre-K students, he/she will hear, “Which of the following items begins with the letter B?” The picture in this question represents an item familiar to children of this age; however, quiz item 5 contains items that are unfamiliar. The voice in the hyperlink identifies, and consequently pronounces, items 1, 2, and 3. In this way, the student learns the name of the item and the letter C, which also appears written below the hyperlink.

**Engineering K12 Center**

The American Society for Engineering Education (ASEE) has a site for K-12 students. This site is dedicated to introducing engineering to students in secondary schools. By explaining the basis for engineering and its various disciplines, ASEE gives students a detailed understanding of the engineering profession. It is a great resource for both students and teachers. The ASEE site has both project ideas and informational website links to aide teachers in teaching engineering in both elementary and secondary schools. The student is given information and access to various engineering societies and colleges. There is a hyperlink from the Engineering Alphabet site to the ASEE K-12 site [7].

**Institute**

The Institute for Technological Scholarship was established at Tennessee Tech University two years ago to help the faculty and staff form cutting edge practices in their teaching, service and research. This project has been partially funded and supported by the technical staff of the Institute for Technological Scholarship.
Some of the comments made by the students and teachers have been listed below:

- It hard to hear the questions sometimes. Volume control is very important.
- Linking the vocabulary to letters is an excellent teaching source.
- I wish this would become a commercially available tool.
- More engineering terminology, tools, and majors should be added.
- I needed more time to complete the tests.
- It takes time to access the site and tests when you dial up.
- It is taking a long time to have all the pictures and animations downloaded in one page.
- Computer screen size is a factor. When you have a small size screen, it hard to see the beauty of the tool.
- More developments should be done in quizzes. More quizzes are required.
- Gender diversity, race, and age are important factors. In your figures, recordings, and tests, these factors should be considered.

Overall, the initial development and beta testing was a great success. Based on comments by students and teachers who participated, more revisions and additions are underway in the initial development.

**CONCLUSIONS**

It is very important to introduce the concept of engineering when children are very young. This WebCT based tool was developed to introduce engineering to five-to-eight year old students via online teaching, quiz and glossary links. Initial development has been tested in local schools and adjustments made based on feedback from the students and teachers who navigated through the course. Results of beta testing have shown that developments such as this one are effective in addressing the lower math and science scores of U.S. students. The inclusion of women and minority engineers in the examples throughout the course will introduce these under represented groups to the engineering profession at a young age (see figure 1).

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**REFERENCES**


