

Enhancing Usability by International Students of a Distance Learning Web Site

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Abstract— This paper discusses how a Web site created for computer science courses at an American university has been made more accessible to international English-reading students. The suggestions are based on experience with a site that has proven to be popular among students around the world. The Web site, chortle.ccsu.edu, contains several complete courses on basic computer science topics.

Keywords—distance learning; Web site usability

I. INTRODUCTION

The Computer Aided Instruction Web site at the Computer Science Department at Central Connecticut State University (CCSU) contains several on-line courses on computer science topics. The material is freely accessible to anyone with a Web browser. From its beginning in 1997 the site has been popular with users both on and off campus, and has had heavy international use. Of the 15 million page requests made to the site, 25% have been from nations where English is not the primary language.

The heavy international use has encouraged the first author to deliberately write for users whose first language is not English. The site is written in English, but the writing is aimed at students whose English may be weak. The international popularity of the site is evidence that its instructional style and writing style work well.

The most popular course on the site teaches the programming language Java. This course is being translated into German by the second author. His site, www.gailer-net.de/tutorials/java/java-toc.html, is used for instruction at *Bildugszentrum der Stadt Nurnberg* and is freely available on the Web. That site received 350,000 page requests in its first year, primarily from German-speaking users.

Our experience has been that the features that ease access of the site for international students also ease the translation of the site. Working with a translator has uncovered many ambiguities and cultural allusions that may be cryptic to non-American students. It is likely that writing for an international audience has also improved the usability of the site for students in the US.

II. INSTRUCTIONAL STYLE

A. Programmed Learning

Web page authors are urged to write for an interactive audience [1,2]. Web pages are not merely electronic delivery of a printed book, but are an active medium where readers expect to be in control. Instruction should be interactive and should constantly engage the reader. Interactive presentation of text can easily be accomplished using the techniques of *programmed learning* implemented by using hyperlinks between Web pages. Programmed learning is a model of interactive presentation in which instructional material is divided into a large number of very short lessons [3]. Each lesson consists of a few paragraphs of instruction followed by a short question or interactive exercise that reinforces the lesson. The student gets immediate feedback when the next lesson shows the answer to the question. The student then reads the next short lesson.

In a *linear program* the lessons are linked together into a single chain. All students are presented with the same sequence of lessons. Students work their way through the material by alternately reading and answering questions. The question or exercise at the end of each lesson is easily answered by using the information in the lesson. The lessons are designed so that students can answer most questions correctly and can work most exercises without difficulty. Students are continuously rewarded by the pleasure of correctly using the knowledge they have just gained. This makes the student an active learner, resulting in better comprehension and retention. More than 40% of about one hundred studies show that programmed learning is superior to traditional material. In the remainder of the studies, programmed learning is equally effective, or rarely, less effective [3].

Most of the instruction on the site uses programmed learning. Each short lesson is one Web page. The question or interactive exercise for each page is placed at the bottom with a link to the next page in the program. Students are encouraged to think about the question or to do the exercise before proceeding to the next page, although there is no mechanism to force them to do so [4,5].

Programmed learning accommodates several other recommendations for good Web writing. Web sites are best if

they deliver short chunks of text, rather than long blocks [1,2]. Because of search engines, users might start reading the material at any page. Pages should be self-sufficient or lead the reader to the start of a topic.

B. Student Reaction to Programmed Learning

It is possible that part of the success of the site is due to its use of programmed instruction, although there is little direct evidence of this. The Web server log files show that most users quickly download all the material in several chapters at once, presumably to then read the material off line. However, investigating usage patterns is difficult because the complete Java lessons are available in a zip file that can be downloaded by ftp. This is especially popular with international users, who frequently have slow Web access. Presumably, users who like the interactive style download the complete set of lessons and use them at home.

Users from around the world often send e-mail expressing their success with the site. Of 250 e-mails, only one made a negative comment about the programmed learning style.

The material is used in lecture for several courses at CCSU. Although the evidence is anecdotal, foreign students seem to do better with this material than with some standard textbooks. Especially with computer science, textbooks sometimes contain rambling paragraphs and needlessly complex sentences. The discipline of writing short lessons that fit one per Web page minimizes both of these problems.

III. SITE CREATION SOFTWARE

The Java lessons consist of 80 chapters of about fifteen short lessons each. The individual Web pages could be created by hand, but with approximately 1200 pages this would be tedious and prone to error. Instead, each chapter is created as a single source file. The divisions of the file into Web pages, and the sections of each Web page are marked using XML tags. A software tool breaks up the source file into individual page files, puts in the boiler-plate HTML, and automatically sets the links between them. This approach has proven invaluable for a site that is under constant revision. It has also been of great help to the translator, who has merely to translate the text without dealing with formatting and HTML. A disadvantage of this approach is that conventional site creation tools such as Dreamweaver™ cannot be used.

The source file for each chapter can contain any HTML tag. This allows pages to contain images, frames, JavaScript, audio, and anything else that Web pages may contain.

IV. WRITING STYLE

The site is written with the expectation that English-reading international students will visit it. Writing for the Web imposes a style different from writing for a printed book. Many of these differences also enhance the usability of the site by international students and ease translation. Several authors and Web sites make recommendations such as the following [1,2,6]:

- Write short and simple sentences.
- Make paragraphs much shorter than in textbooks. There should be no more than one concept per paragraph.
- Illustrate ideas with graphics and examples.
- Write in active voice and use the present tense.
- Use words in their most common form.
- Avoid uncommon words.
- Repeat a noun in a sentence rather than use an ambiguous pronoun.
- Limit the number of modifiers of a noun or verb.
- Use connectives *that* and *which* even where they could be eliminated. For example, “the instruction *that* just executed” is less ambiguous than “the instruction just executed”.

Textbook writing is often needlessly complex. The grammar is often complex and sentences are far too long. Paragraphs are introduced with sentences that add little other than literary style. Eliminating these problems is surprisingly hard. It is hard to see them in your own writing, especially just after it has been written. But after several months, the faults become clear. They also become clear when the work is revised for translation. An advantage of writing for the Web is that the author can revisit pages at any time and improve the writing.

There are internationalization problems with number formatting, date formatting, and currency [2,6,7]. English-speaking countries use a period to separate units from tenths and use commas to separate groups of three digits, as in 12,234.67. Other countries use other styles. The ISO standard is to use comma to separate units from tenths and space to separate groups of three digits, as in 12 234.67. Unfortunately, when HTML is displayed, this style sometimes comes out 12 234.67. The browser sees the space as legal location for a new line. Worse, it is unclear to many readers if the space is intended or is an error. For the CCSU Web site, numbers are formatted in the American style. Most users are likely to understand this style even if it is not the one they customarily use. In the German translation, numbers are formatted appropriately for Germany.

Dates expressed as 4/5/04 are ambiguous. This issue is easily avoided by spelling out dates. For the CCSU Web site, currency issues are not a problem except in a few example programs that calculate with dollars and cents. But most users understand dollars and cents well enough to follow an example, even if their local currency is something else.

Allusions to American holidays such as Thanksgiving, and religious holidays such as Easter should also be avoided. But American students like examples that use holidays. Removing all holidays seems like too great a cost for the possible gain in usability. The CCSU site uses some secular holidays in its examples.

V. OTHER INTERACTIVE FEATURES

The CCSU pages have many interactive exercises, frequently used as the line between short lessons. These are implemented using HTML forms with buttons and textfields, sometimes interacting with short JavaScript programs. Typically, an exercise asks the reader to work out a problem or to fill in a blank. When the reader clicks on a button, the answer is displayed. There is no way to tell how effective these exercises are with distant students. However, they are popular with students in the classroom.

Some of the material on the site teaches MIPS assembly language programming. This material is used in several universities around the world, and was proposed for a distance education course taught in Thailand for students in Vietnam. Although this proposal did not reach fruition, the Web pages on assembly language have been enhanced by having their author read each page into an audio file. The idea was that Thai and Vietnamese students would like listening to a professor from an American university read technical material.

These audio files have proven surprisingly popular with all students, not just foreign. Of course, they are popular with classroom students who have skipped lectures (and might contribute to those lectures being skipped), but students in distance parts of America and Europe constantly download them, also. The reason for this is not clear.

Their popularity is especially surprising in that the audio files are in the non-compressed “.wav” format. (The original project was to use a compressed format, but this was never completed.) The audio consists of 720 files, comprising 250 megabytes—not something to download over a slow modem.

The pages are written so that users can avoid downloading the audio files. Also, since each page has its own audio files, users can select only what they want. In the future, the audio may be converted to MP3 format, which will reduce the files to 30% of their original size. But the size of the files is still huge compared to the size of HTML text files, and probably still too large for effective international use.

VI. PROBLEMS

Web writing is sometimes encouraged to be conversational and interactive, not a lecture. With a conversational writing style, the writer may use casual speech and interject allusions to popular TV shows or recent news events, and use humor. Although these features might be desirable for an American audience, it is a problem for foreign students.

The first author was not aware of how pervasive allusions to American culture were in the material until the translator questioned some of them. For example, one page said “Java is free, unless you get it at Starbucks”. This sentence makes little sense outside of the US. Other pages mentioned other things that American students are likely to know about, such as the last season of a TV show. Some of the humor on the site was

standard American professor humor, probably remembered from lectures decades ago.

These conversational features go against the goal of usability by international students. But removing them decreases the readability of the material by American students. Some pages lose their sparkle when rewritten in a formal style. Another consideration is that international students might want the casual language of the site so that they can practice conventional English.

The best approach to the problem is to keep a reasonably conventional tone in most of the writing, but to be sure that key concepts are explained carefully. Most concepts are illustrated by examples and worked problems, which further minimizes confusion.

Other problems are that many international users use older Web browsers and their Web connections are slow. So graphics need to be kept small. Until recently, the CCSU site was designed for Netscape Navigator at a resolution of 640 by 480 with Web safe colors. Recently, these restrictions have been relaxed, but at the cost of a few international complaints. There is a great diversity of browsers used outside of the US. Many of them run on non-Windows operating systems. Testing the site on all types of browsers is impractical. The best approach here is to keep the HTML of the site several years behind the current standard, and to keep the layout simple. Because of this, the appearance of the site is less sophisticated than many modern sites.

Java applets are used sparingly. Often, international users cannot run applets, and sometimes users are behind firewalls that block applets, or have browsers set to not run them. There are fewer problems with short JavaScript programs, but pages must be written to be useful when the programs fail.

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