A Study on the Design and Evaluation of an Adaptive Web Browser for Students with Reading Difficulties

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Abstract
The web-based learning has been becoming an important channel for the education renovation. However, the children with reading difficulties, including the mental retardation and learning disabilities, have difficulties with word decoding and comprehension. To learn from the Internet, they are facing two challenges in manipulating browser to read through the web and comprehending the contents on the web pages. The Adaptive Web Browser (AWB) in our design, integrating the technologies of HTML interpreter, text-to-speech engine and picture communication symbols (PCS), facilitates comprehending the contents on web pages with auxiliary speaking sound or picture produced automatically as needed. In examining its usability, the result indicates that the Adaptive Web Browser can help the students with reading difficulties facilitate access to the web and increase comprehension of contents on the web pages.

1 Introduction
Accessing the Internet has been becoming one of the basic skills for all students. They should learn to use the browser, such as Internet Explorer, to surf the Internet. In order to use the functions provided by browsers, students must have a good conceptual model of the system. They must also recognize the words shown on the web pages to understand the meaning of the contents. However, students with reading difficulties, including mental retardation and learning disabilities, cause problems in developing well conceptual models of the interface and in developing word recognition abilities of the meaning of written language [2].

By means of auxiliary voice and pictures, learners could understand the words shown on the web pages that they could not recognize [1][3]. Thus, the purposes of this research are to design an AWB with the PCS and synthesized Chinese text-to-speech engine, and to evaluate the usability of the AWB.

2 Design of AWB

2.1 The Framework of AWB System
AWB is developed on the basis of the Microsoft Internet Explorer engine running on the Windows platform. The AWB system includes two major components; one is the Chinese text-to-speech engine used as a voice output producer, the other is the PCS database acting as the source of pop-up images to assist the children in reading on the Internet. The integrated AWB software is installed at the client side.
2.2 The Features of AWB System

2.2.1 Simplified Interface. Considering the users’ cognition abilities, we modify the toolbar of AWB with functions used most frequently in IE. With voice description for the functions on the toolbar, users could easily learn to interact with the AWB.

2.2.2 Voice and Picture Assistance. The AWB could read out the word or sentences highlighted by the users in synthesized voice output. Users could listen to the contents of the web page instead of reading. And by connecting to the database with about 3,000 pictures, the AWB can automatically pop-up the corresponding PCS near the target word or phrase as the user move the mouse over it. In the same time, the AWB can speak the target word out by clicking the right button.

3 Evaluation of AWB

3.1 Method of Evaluation

We conducted an experiment to evaluate the usability of the AWB. The items for evaluation include the simplicity of the interface operation, and the effectiveness of assisting reading comprehension of the AWB. In order to avoid the sequence effect of the experimental materials and browsers, we arrange the sequence of reading browsers and interchange the articles for the browsers randomly. The test score will be computed and analyzed in repeat measurement T-test.

3.2 Result

There are 10 7th to 9th grade students with moderate mental retardation selected to participate the evaluation. Three of them are female and seven ones are male.

3.2.1 The Simplicity of The Interface Operation. The mean of correct response is shown on Table 1. As Table 1 indicates that the interface of the AWB is very simple and easy for the learners with moderate mental retardation to learn to operate correctly in a short period.

<table>
<thead>
<tr>
<th>Function</th>
<th>Forward</th>
<th>Backward</th>
<th>Refresh</th>
<th>Stop</th>
<th>Go</th>
<th>Speak</th>
<th>Picture Assistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3.9</td>
</tr>
</tbody>
</table>

Table 1 the mean of correct response on each function button and picture assistance (n=10)

3.3.2 The Effectiveness of Assisting Reading Comprehension. The subjects’ performance of reading comprehension by utilizing IE and AWB was shown on Table 2. The result indicates the mean scores of using these two browsers are significantly different based on the result of the t-test (t=3.14, P<.05).

<table>
<thead>
<tr>
<th>Browser</th>
<th>IE</th>
<th>AWB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.10</td>
<td>4.90</td>
</tr>
<tr>
<td>SD</td>
<td>1.97</td>
<td>.32</td>
</tr>
<tr>
<td>T</td>
<td>3.14*</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 the subjects' performance on two browser (n=10)

Note: * presented P < .05

Reference