A VISUAL TRAINING DEVICE FOR LEARNING CHINESE CHARACTER OF CHILDREN WITH DEVELOPMENTAL DYSLEXIA

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Abstract: A visual training device (the visual training tool) has been developed to assist in the recognition and understanding of Chinese characters (Kanji). The visual training tool presents that strokes of a Kanji character are separated and reconstructed. The visual training tool method was more effective than the traditional Japanese teaching methods for learning Kanji among Japanese children with developmental dyslexia (Yamazoe et al., 2008). In the present study, we developed and evaluated the web-based visual training tool for Japanese children with developmental dyslexia. The findings of the present study indicate that the web-based visual training tool is effective for Japanese children with developmental dyslexia to memorize and to write Kanji strokes.

1 INTRODUCTION

Developmental dyslexia is a specific impairment of the ability to read and write which is neurobiological in origin (Lyon et al., 2003). In some English-speaking countries, dyslexia affects about 5 to 10 percent of the population (Shaywitz, 1996). It is a phonological deficit characterized by difficulty in associating spoken sounds (phonemes) as represented in written language. One of the deficits in children with developmental dyslexia involves the ability to analyze component phonemes of words, sometimes referred to as phonemic awareness. Japanese writing system is very different from that of English. Japanese researchers generally attribute these reading and writing impairments among children to visual processing problems (Uno & Kamibayashi, 1998) rather than phonological processing problems.

The Japanese writing system consists of two qualitatively different scripts: Kanji and Kana. Kanji is both logographic and morphographic and is derived from Chinese characters. Kana consists of two syllabic forms, Hiragana and Katakana, which are derived from Kanji (Sampson, 1985). These three scripts are used to write different classes of words. The commonly used method for teaching Japanese children involves the teacher demonstrating the stroke order of the characters, and then the children repeatedly write the same exact stroke order. Kanji contains the largest amount of characters among the three scripts. During the six years of primary school education in Japan, children are introduced to 1,006 different Kanji characters. Each character of Kanji contains specific stroke orders. On average, there are about 12 strokes in the Kanji characters designated for common use in Japan. The stroke order for Kanji characters is generally fixed; therefore, it is very important for children to learn the proper stroke order. Japanese children with developmental dyslexia face a monumental challenge of learning a large number of kanji characters. Individuals with developmental dyslexia have difficulties with separating Kanji characters into components, patterns, or strokes. Japanese children with developmental dyslexia struggle with understanding the aggregated structure

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of Japanese characters. These factors are believed to contribute to impeding the acquisition of literacy skills. Traditional Japanese teaching methods may not be suitable for Japanese children with developmental dyslexia. Japanese children with developmental dyslexia have more problems writing Kanji rather than reading Kanji.

Recently, computers have been used to assist students with developmental disabilities to improve their languages skills (Johnson et al.,1987; Torgesen & Young, 1983). The widespread use of computers in Japanese primary school education now enables computer-assisted training in Japanese language writing for children with developmental dyslexia. Through computer-based teaching and learning, children be able to effectively acquire various language skills. While many computer-assisted Kanji-learning systems are available in Japan (Komori & Zimmerman, 2001; Takesue et al., 2005), the most commonly used systems include: the model character being displayed with the stroke order information; or the stroke order of the Kanji characters is animated. These system present two challenges. First, they require the users to physically write the Kanji characters while looking at the model. The users must repeatedly write the characters until they learn them. Second, the speed of the animated Kanji characters cannot be adjusted, which presents difficulty to individuals with developmental dyslexia who have been shown to be less sensitive to motion stimuli and psychophysical integration (Raymond, 1998).

Studies have shown that people with developmental dyslexia possess impressive talents in various fields (Shaywitz, 2005). The authors of the present study focused on one of those talents, which is phenomenal visuo-spatial recognition ability (von Károlyi et al., 2003). Children with developmental dyslexia are able to recognize the structures of hiragana characters much easier in a literacy learning using visuo-spatial recognition (Yamazoe et al., 2009). The authors have developed a visual training device (visual training tool) to present Kanji characters on a computer (Yamazoe et al., 2008) that uses neither animated Kanji characters, nor writing repetition. The visual training tool separates the Kanji character into individual strokes, and then the strokes are reconstructed (see Figure 1). The results suggested the possibility of subdividing a Kanji character as a tool for Japanese children with developmental dyslexia to learn to write Kanji characters (Yamazoe et al., 2008). The aim of this study is to test the efficacy of web-based visual training tool in the literacy learning of Kanji characters. In the present study, we propose the advantage of using the visual training tool with web-based learning to assist Japanese children with developmental dyslexia in learning Kanji characters.

2 METHOD

2.1 Visual Training Tool

The visual training tool made for learning through web-based. The user of a web browser is able to request for Kanji leraning of web pages by accessing the visual training tool site. Figure 1 shows the visual training tool. Two sessions were prepared. The first session displays the target Kanji information, and the second sessions presents the visual training (see Figure 1). The subject uses the mouse to operate the control buttons on the screen. In the first session, the subject learns how the character is read, how many strokes are used, and the context in which the character is used. The numbers indicate the stroke order, and the arrows display the brushstroke direction. In the second session, the subject uses the mouse to drag and drop the strokes into a square frame one by one to reconstruct the character(see Figure 1 No.2, 3). The correct answer is appeared by clicking the answer button (see Figure 1 No.4) The subject repeats this sequence five times. This repetition is intended to enhance the subject's memorization of the stroke forms and positions. Adobe Flash CS4 was used to create the visual training tool.

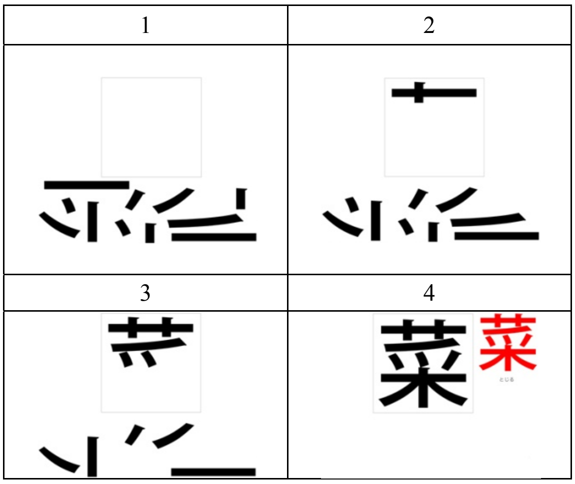

Figure 1: Visual training tool.

The panels represent the visual training tool used in this study. The panels show an example of "菜[na/sai]"in the visual training session.

2.2 Participants

One girl and two boys (Boy 1, Boy 2) with developmental dyslexia (mean age = 10 years) participated in this study. The children and their parents agreed to participate in the study after being given a brief description of the experiment. These children had encountered difficulty learning to write kanji using traditional Kanji teaching methods. These children have above average intelligence (participant mean full scale WISC IQ of 124, SD=15.9), but they had not yet acquired the Kanji writing skill level comparable to children of their same grade. They could not write the Kanji characters that were used in this experiment.

2.3 Experimental Setup

The experimental setup included a computer at home for each participant to provide the means of delivering the visual training tool online access. Eight different Kanji characters were selected for each child in this experiment (see Table 1). Each participant had not previously mastered these Kanji characters. Participants of a web browser are able to request for the target Kanji characters of web pages by accessing the experimental visual training tool site.

Table 1: Target Kanji characters for each participant.

Participants	Target Kanji characters
Girl	博(haku), 副(fuku), 菜(na/sai), 標(hyou), 置(chi), 機(ki), 象(shou/zo), 残(zan)
Boy1	禁(kin), 確(kaku), 張(chou), 移(i), 営(ei), 築(chiku), 設(setsu), 解(kai)
Boy2	秘(hi), 訪(ho), 推(sui), 将(sho), 奮(fun), 操(sou), 密(mitsu), 聖(sei)

2.4 Procedure

This study consisted of three main parts: pre-test, Kanji learning with the visual training tool, and post-tests. The pre-test and post-tests assessed the ability to write the target Kanji characters for each participant. During the pre-test, the target Kanji characters were read aloud and then the participants were asked to write the characters. The second step involved each participant learning the target Kanji characters using the visual training tool with the participant's home computer. Participants learned one Kanji character each week during two weekly sessions for a period of eight weeks with the visual training tool. In the post-tests, once again the target Kanji characters were read aloud and the participants were asked to write characters. The post-tests were conducted one month after the experiment, and again two months after the experiment. After the post-tests, the participants were interviewed and then provided several comments about the visual training tool.

3 RESULTS

Figure 2 shows the results. The horizontal axis represents the measure of writing skill, and the vertical axis indicates the percentage of correct answers. The girl who had no correct answers in the pre-test scored 75 percent in both post-test 1 and post-test 2 (i.e., answering six out of eight characters correctly). Boy 1 who had no correct answers in the pre-test scored 88 percent in post-test 1 (i.e., answering seven out of eight characters correctly), and 75 percent in post-test 2 (i.e., answering six out of eight characters correctly). Boy 2 who had no correct answers in the pre-test scored 88 percent in both post-test 1 and post-test 2 (i.e., answering seven out of eight characters correctly). The effectiveness of the proposed visual training tool was evaluated by One-way ANOVA. The post-test1 and 2 were significantly different from the pre-test ($p < 0.01$). There was no significant difference between post-test 1 and post-test 2. As a results, under the conditions of the visual training tool after the pre-test, all three participants showed a significant improvement of correct answers in both post-test 1 and post-test 2. In the interview conducted after the post-tests, the participants had several comments about the visual training tool. The comments include: "It was easier to learn Kanji with the visual training tool than with traditional methods," "I could learn the structure of Kanji with the visual training tool," "It was fun learning Kanji with the visual training tool," and "I was able to memorize the Kanji with the visual training tool."

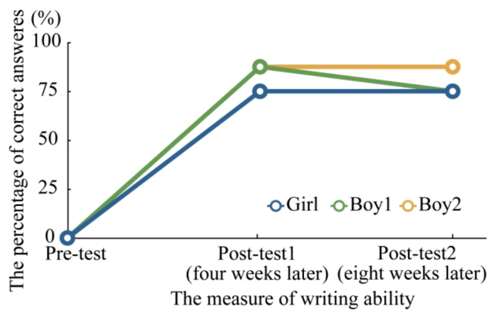

Figure 2: Percentage of correct answers for each participant.

4 CONCLUSIONS

The purposes of the present study were to evaluate: 1) the advantage of using the visual training tool for teaching Kanji characters; and 2) the effectiveness of the visual training tool for retaining Kanji characters in the long-term memory (eight weeks) of Japanese children with developmental dyslexia. Figure 2 shows that the percentage of correct answers was a significantly higher in both post-test 1 and post-test 2. The data suggest that subdividing the strokes of the Kanji characters and then reconstructing the strokes reinforce the memorization of Kanji characters. The improvement of their long-term memory (eight weeks) was attributed to the web-based training method of retrieving and reconstructing the stroke order. This method not only improves acquisition of Kanji but also it is more enjoyable for children with developmental dyslexia.

Stromer et al. (1996) studied the effectiveness of a computer-based word construction procedure to teach spelling to the individuals with mental retardation and hearing impairments. In their study, the subjects were first instructed to match sample pictures with the correct printed words, and then reconstructed the correct word by selected the letters from a ten-letter anagram. Stromer et al. reported that the subjects improved not only their anagram spelling but also their writing performance as well. The present visual training tool study confirmed the results of the Stromer et al study; i.e., web-based procedures are useful for teaching Kanji as well as the alphabet.

The present study demonstrated the effectiveness of the visual training tool to retain Kanji characters in long-term memory (eight weeks). To further improve the visual training tool, the authors are currently planning to evaluate the potential of longer-term memory (over eight weeks) of Kanji characters for Japanese children with developmental dyslexia. We also plan to investigate the effectiveness of the visual training tool on Chinese children with developmental dyslexia and foreign students of Japanese as a second language.

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