Effectiveness of Learning Chinese Character Using Tablet Technology

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Abstract. Bad handwriting often results in bad academic performance and discourages students from learning. Tablet technology has given character learning a new form such as writing by fingertip and various selection of background color. Without holding a pen, it is less stress and more intuitive for character-learning children. With certain background color, child seems pay more attention on writing. In this research, we piloted an evaluation to which we investigated whether learning by the tablet features is better than traditional paper-and-pencil learning. A third-year elementary student who is in the age of first learning Chinese characters was employed to this study. Different background color, stroke thickness and writing methods were tested. The results show that no significance between but aesthetics. There are steady stroke, slanted character, ratio and distance. And these aesthetics appear in specific colors strokes and background, thick and thin strokes or by finger and stylus writing.

Keywords: handwriting, tablet, color, stroke, background.

1 Introduction

In Taiwan, Chinese character writing is one of the many major aspects of an elementary school student's school life. Outside of Chinese class, Chinese writing is also a tool intensively used for learning in other classes, such as taking lecture notes and exams. Each elementary school student does a tremendous amount of writing every day.

Although writing itself is the means, not the objective, (Hallahan, Kauffman, & Lloyd, 1996), low effectiveness of handwriting results in poor academic performance and weak learning confidence (Mather & Roberts, 1997). Young students often struggle to pay attention in class, and the lack of focus contributes to their inefficiency in writing activities. To increase students' learning effectiveness, multimedia technologies have been integrated into lectures, taking the dullness out of classrooms. For example, competitive games motivate students to learn spontaneously; tablet PCs have become popular and have replaced traditional PCs' unintuitive input using the mouse and keyboard (Donker & Reitsma, 2007).

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Technologies have been gradually applied to teaching and learning as assistive tools over the years. Tablet PCs are the most preferred as they are light-weighed, generate immediate feedback, and provide intuitive handwriting functions, allowing students to practice and learn on one electronic gadget. Roslyn High School in New York, United States purchased US$750 iPads for their two experimental classes, and hopes to eventually provide iPads to all 1,100 of its students. A school in Virginia, United States uses iPads to improve interdisciplinary learning (Allen, 2011), and even their kindergarten students have started to use them for educational games. The Taiwan Ministry of Education will enhance teachers' integration of information technology into teaching as a policy of the year (Ministry of Education, 2011). And Taiwan's National Science Council and the Ministry of Education have launched experimental programs to promote the use of e-books, and the implementation outcome will be evaluated in elementary schools. For example, the electronic experimental class at Cambridge Primary School in Taipei County chooses iPads as its electronic teaching tools because of the long-lasting power and rich functionalities. Because of the popularity, light weight, the handwriting-featured touch screen and the well-developed assistive writing software that overcomes traditional teaching's limitations (Hulls, 2005; Yu, Zhang, Xue, & Zhu, 2010), we select tablet PCs as our main tool for studying students' handwriting characteristics.

2 Literature

Characters serve as the medium of communication in written Chinese. The ability to write reflects children's academic achievement at school (Morris, 1982). Chinese characters are complicated and do not necessarily represent pronunciation. Traditionally, learning Chinese characters requires a lot of imitation and practice using pen and paper. As technology advances, "finger writing" has replaced the traditional method of learning characters; however, little research has explored the efficiency of learning characters using finger writing. This is a pilot research aiming to investigate whether using different writing tools (finger and pen) will affect a student's writing performance.

2.1 Writing Skills in Children

Language is a critical medium for teachers to convey knowledge and to build students' understanding. Language skills include listening, speaking, reading, and writing, and writing ability is built on the other three abilities. Writing is usually used to show students' learning outcomes (e.g. answering questions in a test) (Morris, 1982; Smith, 1991) and to remember information. Although handwriting has been mostly replaced by typing, it is still the most intuitive, convenient and essential tool in everyday life.

Johnson and Myklebust (1967) addressed four fundamental abilities acquired before one can write effectively:

- Hearing: auditory memory, phonetic ability, auditory discrimination, the ability of following instructions, and the ability of processing sensory information.
- Vision: visual orientation, scanning skills, visual perception, visual memory and imagery.
- Movement: gross and meticulous motor coordination.
- Language acquisition: semantic network and linguistic experience.
- According to Taiwanese special education scholar Lin (2001), there are three major issues in children's Chinese character writing as they develop:
- Writing errors.
- Writing behaviors: the difficulty to focus, slowness, and carelessness.
- Writing gestures: awkward pen grips, excessive strength, and poor postures (Lin, 2001).

2.2 Using Tablet PCs for Learning

Tablet PC is a new multimedia tool. It can be used not only as an e-book reader, a gaming device, and an Internet browser, but also as an instructional tool in multiple forms. For example, reading stories to kindergarten children using sound effects and animation on a tablet PC enables them to actually experience story plots.

Hulls (2005) indicates that young students are more able to focus in class when they write on tablet PCs using strokes of different colors. Consequently, students receive better grades in class. He compares the advantages and disadvantages between using traditional teaching equipment and tablet PCs (Hulls, 2005).

Chalks and Blackboard

- Advantages: It is easier for instructors to draw students' attention to a specific spot. Instructors can also maintain direct interactions with students in the classroom.
- Disadvantages: There is a difficulty inherent in presenting complexity. Pictures and schematics are sometimes too complicated to be drawn on the board (Felder & Brent, 2005; Hulls, 2005). It can possibly yield errors in students, since they have limited time understanding the material during class and may not see the importance of subtle details. It is unlikely for students to retain what is exactly presented on the board for future reviews (for the purposes of doing assignments and preparing for exams); it is also impossible for instructors to record the lectures for future updates or revisions.

PowerPoint Presentation

- Advantages: They are attractive and in a clear format. Students can access to class materials both digitally and physically.
- Disadvantages: Being able to obtain lecture notes beforehand can reduce students' motivation to learn in class, and the multimedia features may also distract students.

Electronic Projection

- Advantage: It is convenient to show supplementary materials (e.g. animation, videos).
- Disadvantages: Its presentation is not as clear as that of a blackboard, and it decreases direct interaction between the instructor and students. It can be time-consuming.

Electronic Projection and Digital Ink

- Advantages: It can demonstrate lecture materials clearly as well as attract students' attention. It also generates feedback, motivates students, and increases in-class interaction. It supports the presentation of animation, videos, and visual effects. It is great for the retention of teaching materials, which can also be sent electronically to students.

Tablet PCs can also be used educationally as tools to improve reading ability.

McClanahan et al. (2012) studied a child with attention deficit hyperactivity disorder (ADHD); in their study, they helped him recognize compound words and comprehend reading. They downloaded applications on an iPad and used it as a teaching tool to help the ADHD child learn. The child was able to use applications to record himself reading and replay it. Those applications also helped him to identify the parts he read with his fingers. The researchers found that the ADHD child performed better in literacy and reading afterwards, and he learned to slow down his reading rate in order to correctly pronounce words and to understand main points. His learning attitude became more positive (McClanahan, Williams, Kennedy, & Tate, 2012).

2.3 Effect of Using Stimulus

Writing is a complex task (Amundson & Weil, 1996). Poor writing performance often leads to extended homework hours in children. Illegible handwriting can even affect interpersonal relationships when working in groups (Racine, Majnemer, Shevell, & Snider, 2008). Scholars have used stimuli in studies (e.g. colored screens and animation have positive effects on a ADHD patient's mathematics in-class learning (Lee & Zentall, 2002) and handwriting skills (Imhof, 2004)). Studies show that stimuli enhance the effectiveness of learning, especially in special education settings.

3 Method

To avoid unstable performance (Li, 2000), one male third grader, aged 9, from an elementary school in Taiwan was selected as the participant for this study. He had basic understanding of Chinese character structures, had already learned the characters used in this study, and had experience using an iPad.

3.1 Testing Environment

An Apple iPad was used as the writing platform and the participant's behavior was recorded on three cameras from different angles simultaneously (Figure 1). The participant was tested individually in a clean and quiet room to avoid distractions.

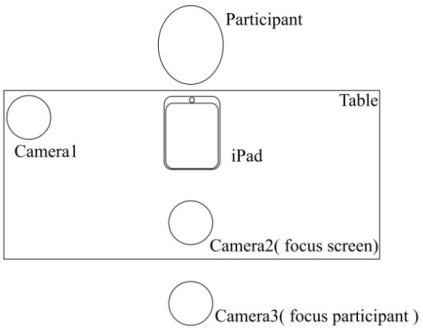

Fig. 1. Testing room arrangement

3.2 Tasks

The participant was asked to complete two tasks(Table 1) on Tablet PC screen by using finger and stylus (Table 2). In second task, the participant was asked to copy writing the given characters as proximal copying (Hallahan et al , 1996).

Table 1. Task description

First task	Second task
Drawing lines and geometric shapes. (triangle, quadrangle and circle)	Writing given Chinese characters.

Table 2. Tools

Two tools to write with:	
Writing on the iPad with a finger.	Writing on the iPad with a stylus.

Three characters (Table 3) for copying were selected from a list of commonly miswritten words (Yang, 2002) and printed in the 300-point BiauKai font on A4-sized papers (Li, 2000). We observed and recorded the participant's writing behaviors, test performance, correctness of the strokes, attention level, and performance rate. The child had already learned the selected characters in his first two years of school, therefore there was no learning effect involved. Additionally, we observed his attention focus by watching his head movements instead of using eye tracking equipment to lower children's psychological or physical stress.

Table 3. List of Chinese characters

Chinese Characters	Meaning in English
媽	Mother
姊	Sister
爸	Father

In the writing process of the Tablet PC, We will change in the different stimulant: color, stroke, writing way. And we divide strokes into two ways (thick strokes and thin strokes). The combination is as Table 4:

Table 4. Color options

Background color on the screen	Stroke color
White	Black
Red	Red
Blue	Blue

4 Results

Overall, the results show that there is no significantly different outcomes when using different stimuli combinations but it yielded aesthetic issues, such as steadiness, slant, proportion, and distance between strokes.

Lin (2001) addressed a few writing issues often found in school-aged children's writing: inaccurate distance between strokes and disproportion between parts. Imhof addressed a criterion used to determine ADHD children's writing performance: slant. Thus, we selected three criteria to evaluate the participant's handwriting performance. The quality of writing is relatively low and unstable when the participant wrote in thinner strokes, as shown in Figure 2.

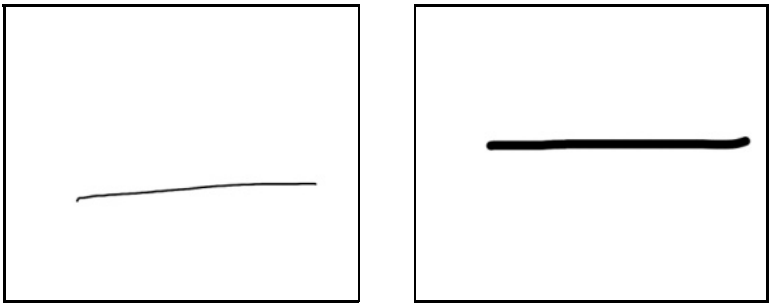

Fig. 2. Comparison of thick and thin horizontal strokes

The character appears to be more slanted when written with a finger than with a stylus (Figure 3).

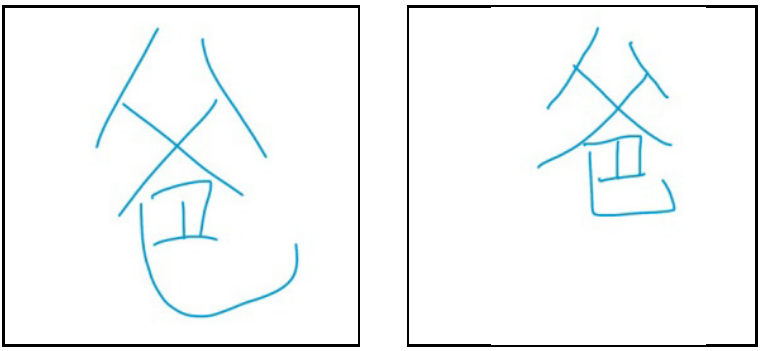

Fig. 3. Left: written with a finger; Right: written with a stylus

As shown in Figure 4 (left), written in blue strokes on a red background, the upper half and lower half of the character are unbalanced in proportions. In Figure 4 (right), the distance between the left and right halves is too wide.

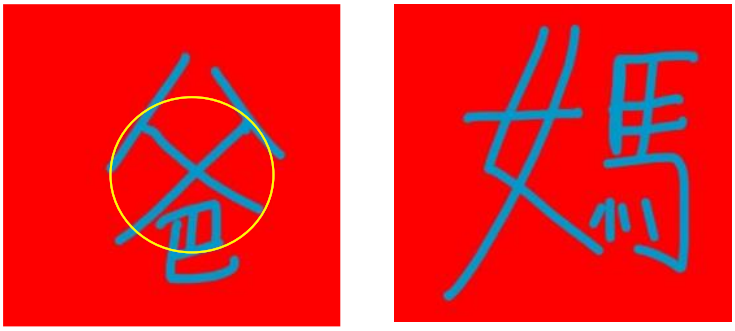

Fig. 4. Left: The upper half is too big; Right: the left half is too big and the distance between the two halves is too wide

When writing with black strokes on differently colored backgrounds, the results are similar (Figure 5).This results are consistent with that of Imhof's study. In his study, the control group (non-ADHD children) presented no significant difference either writing on a piece of white paper or on a piece of colored paper (Imhof, 2004).

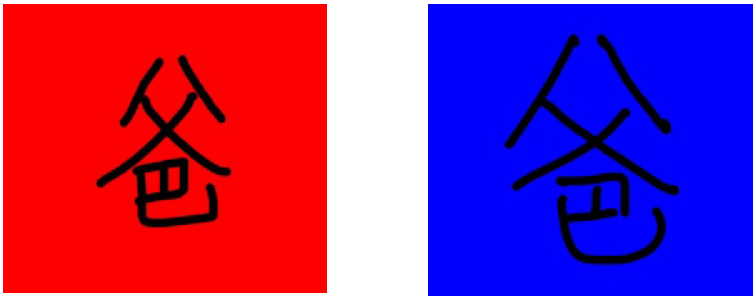

Fig. 5. There is no significant difference between writings in black strokes with a stylus on a red and a blue background

5 Discussion and Conclusions

An interview with the participant showed that he preferred to write in blue strokes on a red background, but he did not perform differently using this combination nonetheless. His handwriting remained legible even though he changed stimuli repeatedly. Therefore, the stimuli did not affect writing results but maintained longer attention during learning. With multimedia technolgy, children can do work while having fun. We suggest that technology can compensate for the limitations of traditional learning methods and it contributes to higher learning efficiency.

In conclusion, from this study, we find that stimuli (background colors, stroke colors and types, and writing tools) do not significantly enhance a child's writing performance. We also suggest that a tablet PC is an appropriate technological device for learning Chinese character writing. Our future research topic of interest will be the study of learning distractions and the role of multimedia in stimulating students' motivation.

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