Is the interactive computerized handwriting training effective to enhance Chinese handwriting performance? A Pilot Study

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Introduction

Most remedial work conducted by teachers to enhance children's handwriting performance or to handle children with handwriting difficulties were by means of repeated practice using paper and pencil tasks. However, children having difficulties in handwriting might even find it difficult to continue the writing exercises with multiple failures. While new approaches such as multi-sensory teaching were also suggested, most of them aimed to remediate the learning process and facilitate memorization rather then enhancing the performance itself of the child. With consideration on the spreading interest in computer-use (Tsang, 1999), an interactive computerized handwriting training program of various basic components (Kwok, 2000; Lally, 1981; Olive & Piolat, 2002; Tseng & Chow, 2000) was designed to motivate children's learning in handwriting with use of a bottom-up approach. This study aimed to investigate whether the handwriting training program incorporating the three major components of handwriting will enhance the 1) visual perceptual skills and 2) visual motor coordination of children, and thus improving the Chinese handwriting performance.

Methodology

Procedure

10 children were recruited via convenient sample from one primary school in Hong Kong. They should satisfy at least one of the criteria for performance component (Grip strength & Pinch strength < 1 SD, or MVPT < 50%ile or VMI < 50%ile) and one of the criteria for occupational performance (POET handwriting speed < 1 SD, or POET handwriting pressure $\pm$ 1SD, or Legibility score < 3).

Recruited children (N=10, age 6-7) were divided into two groups. One of group children (n=5) were arranged to undergo a 8-sessions interactive computerized handwriting training for enhancement of Chinese handwriting performance while another group (n=5) were not receiving any extra training during the period. The 8-sessions interactive computerized handwriting training program were conduct by occupational therapist as group training twice sessions a week. The program consisted of three parts of performance components training

including a) visual perceptual skills, b) visual-motor integration, c) grip and pinch control. There are games which children can perform the training using mouse, the handwriting board and the gripper as the interfaces.

Evaluation on Chinese handwriting performance, visual perceptual skills, visual motor coordination, and tripod pinch strength were conducted before and after the training.

Instruments

The Writing Acquisition System - A digitized writing experiment system named *"Penmanship Objective Evaluation Tool"- POET* (Rosenblum, Parush & Weiss, 2003) Version 2.0 were used to evaluate the handwriting process of the participants. With use of a laptop computer, a WACOM digitizer (which samples pen location, pressure, direction and orientation of pen) and a grip pen, the program enable data capture for handwriting time, length, speed and its variation, and pressure. A 20-word Chinese template was used as the standardized template in this study. The product of handwriting was then given to teacher for legibility rating using a five point rating scale. Rating criteria was based on the quality and legibility of the handwriting product. The higher the score, the better the legibility of the piece of work.

Developmental Test of Visual-Motor Integration (VMI) and *Motor Free Visual Perceptual Test -Revised (MVPT-R)* will be administrated to assess the visual motor integration skills and the visual perceptual skills of the children. Moreover, the EVAL hand evaluation system was adopted for measurement of the tripod pinch strength.

Results and Discussion

In the sample of 10 subjects, ratio of boys to girls was 7:3. The mean age was 88.70 months (SD=3.20 range= 84 -93), equivalent to 7.39 years old (SD= .27, range= 7.00-7.75). All of them were right hand dominance.

Paired t test for the training group showed children were improved in their handwriting performance after the 8 sessions ICHTP training. Result was summarized in Table 1. Statistical significant differences were shown total time ($|t|(4)=3.326$, $p=.029$), on ground time ($|t|(4)=4.531$- 7.170, $p=.002$-$.011$), mean speed ($|t|(4)=4.331$- 6.914, $p=.002$-$.012$), the variation of speed ($|t|(4)=4.758$-11.924, $p=.009$-$.012$), pressure mean ($|t|(4)= 4.846$-5.750, $p=.005$-$.008$) and its variations during writing ($|t|(4)=2.878$, $p=.045$). These results might indicated that the effect of ICHTP in enhancing children's handwriting with a shorter time, higher speed, and lighter pressure.

On the other hand, statistical significant different was only found in pressure mean between the training and non-training group, before and after the ICHTP. Children in training group have a significant drop of pressure exerted on the writing surface during writing (F (8, 2)=6.409, p=.035) in the 6 words template.

Conclusion

This pilot study showed positive results for the effectiveness of the ICHTP in enhancing handwriting performance, especially in terms of the handwriting pressure. Although the program does not showed direct effect on the three performance components (visual perceptual, visual motor integration, and pinch force control), it is believed that it might help in the integration of these components and resulted in enhancement of the occupational performance (Baum & Law, 1997; Fearing, Law & Clark, 1997; Preminger, Weiss & Weintraub, 2004), i.e. the handwriting performance.

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Table 1. *Comparison of performance components and handwriting performance before and after training among the children in the ICHTP training group*

		Before training		**After training**		***T***	***p***
		Mean	(SD)	Mean	(SD)	*(df=4)*	***value***
Performance Components							
MVPT	*Raw score*	25.20	(2.49)	29.60	(1.11)	-2.365	.077
	Percentile	23.60	(22.80)	57.40	(26.08)	-2.355	.178
VMI	*Raw score*	15.60	(1.14)	15.40	(0.89)	.535	.621
	Percentile	47.60	(6.88)	44.40	(5.08)	1.778	.150
Tripod pinch strength (lb)		5.52	(0.77)	5.66	(0.62)	-.337	.753
Handwriting Performance							
Template A	*(6-word)*						
Time (s)	*Total*	24.39	(6.13)	15.64	(3.00)	2.726	.053
	Ground	13.08	(2.71)	7.76	(1.88)	1.579	.011*
	Air	11.31	(4.45)	7.88	(1.65)	4.531	.189
Total length (mm)		859.25	(316.62)	777.40	(100.37)	.749	.495
Speed(mm/s)	*mean*	30.36	(8.71)	54.68	(17.20)	-4.331	.012*
	variation	20.31	(6.60)	37.10	(11.57)	-4.758	.009*
Pressure (N)	*mean*	2.97	(0.12)	2.29	(0.25)	4.846	.008*
	variation	0.44	(0.10)	0.61	(0.06)	-2.878	.045*
Legibility score		2.80	(0.84)	3.00	(0.71)	-.535	.621
Template B	*(20-word)*						
Time (s)	*Total*	139.34	(31.49)	105.43	(18.18)	3.326	.029*
	Ground	56.85	(11.00)	38.00	(6.37)	7.170	.002*
	Air	82.49	(25.65)	67.43	(16.27)	1.709	.163
Total length (mm)		3832.62	(557.29)	3716.01	(589.41)	.774	.482
Speed(mm/s)	*mean*	33.54	(5.68)	48.40	(9.99)	-6.914	.002*
	variation	22.77	(2.85)	31.69	(4.05)	-11.924	.000*
Pressure (N)	*mean*	2.75	(0.15)	1.97	(0.32)	5.750	.005*
	variation	0.61	(0.06)	0.59	(0.05)	-.539	.618
Legibility score		2.40	(0.89)	2.40	(0.89)	NA	NA

* Statistically significant different found, $p \leq 0.05$

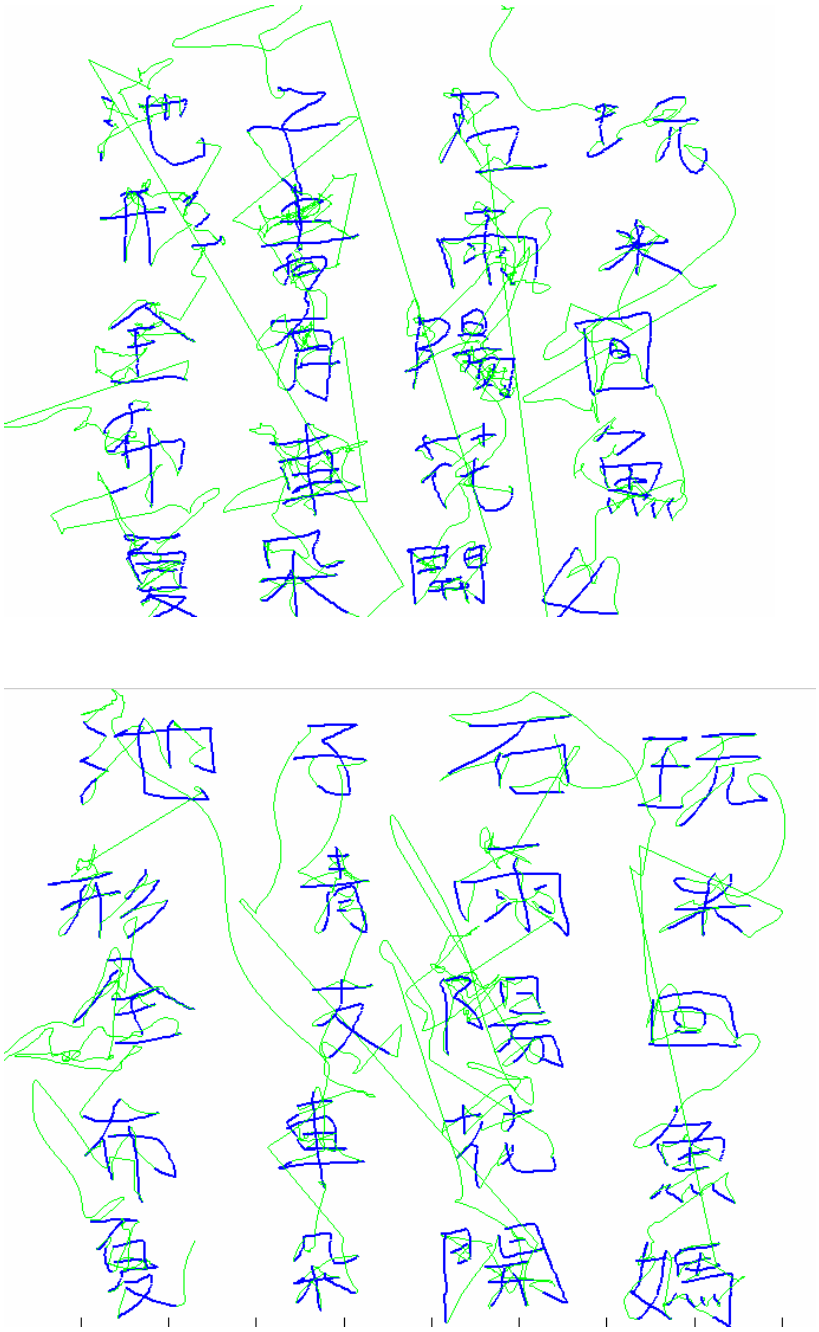

Figure 1. Handwriting samples of the children