Proceedings of 2nd International Congress of Educational Sciences and Development (24-27 June, 2014. Granada-Spain), ISBN-13: 978-84-697-1014-2 2014, pp. 5-9

Colección: Proceedings of International Congress of Educational Sciences and Development

USABILITY OF TACTILE TABLETS TO PROMOTE GRAPHOMOTOR SKILLS IN PUPILS WITH SPECIAL EDUCATIONAL NEEDS: FINDINGS FROM A WORK-IN-PROGRESS

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ABSTRACT. Antecedents. Little is known about the usability of tactile tablets for children with Special Educational Needs. This study tests the usability of a tactile tablet for promoting drawing activity in Down syndrome children. **Method.** Nine children with a Down syndrome drew a house and a person with their fingertip on an IPad® screen (tactile tablet condition), and with pencil on paper (control condition). **Results.** Total drawing scores and total drawing times did not differ significantly across drawing conditions. **Conclusion.** Findings from this work-in-progress failed to demonstrate a higher usability of the tactile tablet over the more traditional paper-pencil technique for drawing.

RESUMEN. Antecedentes. Poco se sabe acerca de la facilidad de uso de las tabletas táctiles para los niños con necesidades educativas especiales. Este estudio pone a prueba la capacidad de uso de una tableta táctil para promover la actividad de dibujo en los niños con síndrome de Down. **Método.** Nueve niños con síndrome de Down dibujaron una casa y una persona con la yema del dedo en una pantalla de IPad® (condición tableta táctil), y con un lápiz sobre papel (condición de control). **Resultados.** Las notas totales de dibujo y los tiempos totales de dibujo no difirieron significativamente entre las condiciones de dibujo. **Conclusión.** Los encuentros de este trabajo en curso no lograron demostrar una mayor facilidad de uso de la tableta táctil sobre la técnica de lápiz y papel más tradicional de la elaboración.

Introduction

The use of writing tools requires learning and many children encounter difficulties holding pencils adequately (Connolly & Dagleish, 1989), which directly affects the quality of their graphic productions (Braswell, Rosengren, & Pierroutsakos, 2007). Children with a Down syndrome often encounter difficulties in pencil holding and in fine motor skills; they are particularly delayed in their drawing ability (see e.g., Clement & Barrett, 1994; Cox & Maynard, 1998). Tactile tablets might be useful for this specific population. Indeed, tactile tablets have a finger-based interface through which users can draw with the fingertip, thereby obviating the need to handle a pen or a stylus, with all the challenges that can bring. We designed the present study to test the usability of tactile tablets for promoting drawing activity in children with a Down syndrome.

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2014, pp. 5-9

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Usability, an important measure for evaluating interactive systems, is defined as "the extent to which a system [...] can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO, 2010). To test the usability of tactile tablets, we measured each component of usability (effectiveness, efficiency, satisfaction) and compared them between experimental (tactile tablet) and control (paper-pencil) conditions. We measured (i) "effectiveness" by graphic scores obtained at two drawing tests (the Draw-a-House test from Barrouillet, Fayol, and Chevrot, 1994, and the Draw-a-Man test from Goodenough, 1926), (ii) "efficiency" by total drawing time (in sec), and (iii) "satisfaction" by the number of children who declared a preference for the tactile tablet over the paper-pencil technique. Under the hypothesis that tactile tablets have a higher usability than paper-pencil for drawing activity in Down syndrome children, we predicted higher graphic scores, lower drawing time, and greater declared preference in the tactile tablet condition compared to the control condition.

Method

Materials

The materials consisted of white sheets of paper, color pencils, an IPad®, and a free app for finger drawing (DRAW app).

Participants

Participants were nine children with a Down syndrome. Table 1 summarizes their main characteristics.

Table 1. *Characteristics of the Down syndrome children who took part in the study*

Child	Sex	Age (years; months)	Pencil Holding	Manual preference	Use of tactile tablets*	Drawing activity*
1	F	6;10	Dynamic tripod	right	4	4
2	M	8	Pre-calligraphy	right	2	2
3	F	8;2	Pre-calligraphy	right	4	1
4	M	8;2	Dynamic tripod	right	4	4
5	M	8;5	Extended fingers	right	3	4
6	M	8;7	Static tripod	right	2	3
7	F	11;7	Static tripod	right	1	3
8	M	12;5	Dynamic tripod	left	4	4
9	M	13	Thumb on	right	4	4

* 1 = never, 2 =once per month, 3 = once per week, 4 = everyday

Design

We used a within-participants design with Drawing condition (2: Tactile tablet/finger; Paper/pencil) and Drawing test (2: Draw-a-House test; Draw-a-Man test;) as main factors.

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Procedure

The children were observed individually at their home by a male experimenter. The parents were present but were asked to not interact with their child during the drawing test. Children were asked to draw two familiar objects (a house, and a person) in two successive conditions: with their fingertip on a screen (tactile tablet condition), and with pencil on paper (control condition). The order in which objects and conditions were presented was counterbalanced across children. The drawings were all made in the morning, such that there were no variation across children in the moment of the day where the test took place. The experimenter recorded drawing times with a stopwatch and the child's declared preference for drawing with pencil on paper versus finger on screen.

The house and person drawings were scored using two standardized drawing scales: the Draw-a-House scale (Barrouillet et al., 1994), and the Draw-a-Man scale (Goodenough, 1926). More precisely, each person drawing was scored on the basis of a system of 51 points, with credits being given for items relative to gross and fine details (e.g., head present, brow or lashes shown), joint, proportion, clothing, and profile. Each house drawing was scored on the basis of a system of 22 points, with credits being given for items relative to gross and fine details (e.g., roof present, curtains present), shape, proportion, alignment, and perspective. Two experimenter who were trained for this activity performed independently the coding of the drawings. The few disagreements observed between judges (< 3%) were resolved by discussion before data analysis. For each child, a total graphic score (0-73 points) was computed as the sum of both graphic scores (the house-drawing score plus the person-drawing score).

Results

Table 2 summarizes the main results obtained for each measure of usability. In terms of « effectiveness », total drawing scores were slightly lower in the tactile tablet condition (M = 17, SD = 7) compared to the control condition (M = 19, SD = 7), but the difference was not significant (Wilcoxon test, p = .066). With respect to « efficiency », total drawing time was slightly lower in the tactile tablet condition (M = 95 sec, SD = 45) compared to the control condition (M = 112 sec, SD = 60), but the difference was not significant (Wilcoxon test, p = .128). Finally, as far as « satisfaction » is concerned, five children declared a preference for the tactile tablet because it was « easier » and « fun » ; two children had a preference for the standard paper-pencil technique and two had no preference.

Note that children who preferred the tablet (n = 5) did not obtain significantly higher drawing scores than those who preferred the paper or had no preference (n = 4) whatever the condition (tablet : M = 19, SD = 7 vs M = 14, SD = 9, p = .365 ; paper : M = 21, SD = 8 vs M = 16, SD = 9, p = .206, Mann-Whitney U tests).

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Table 2. *Summary statistics for each usability measure per child and drawing condition*

	Tactile Tablet Condition			Paper-Pencil Condition		
Child	Total drawing score*	Total drawing time (sec)	Declared preference	Total drawing score*	Total drawing time (sec)	Declared preference
1	15	182	x	23	288	
2	10	50	x	9	76	
3	20	136	x	19	164	
4	7	30		8	38	
5	20	65	x	24	72	
6	6	123		9	127	x
7	29	141	x	30	136	
8	22	88		23	55	
9	23	41		24	50	x
Mean	17	95		19	112	
SD	7	45		7	60	

* Total drawing score corresponded to the sum of the house-drawing score (0-22 points) and the person-drawing score (0-51 points), as evaluated by the Draw-a-House scale (Barrouillet et al., 1994), and Draw-a-Person scale (Goodenough, 1926).

Conclusion

Findings from this work-in-progress (data from 9 participants have been collected so far) failed to demonstrate a higher usability of the tactile tablet (IPad®) over a more traditional drawing tool. Contrary to our hypothesis, effectiveness and efficiency were not significantly higher in the tactile tablet condition compared to the control condition. Satisfaction tended to be greater in the tactile tablet condition but it concerned a small half of our sample of participants only, and it was not related to the obtention of higher drawing scores by the children who declared a preference for the tablet compared to those who declared no preference or had a preference for drawing on paper. Moreover, and in disagreement with our hypothesis, there seems to be a tendency that drawings produced with the finger on the tactile tablet are of lower quality than those produced with pencil on paper. This observation is in line with previous findings by Picard, Martin and Tsao (2014) showing a degraded drawing performance in normally developing children with the finger drawing technique applied to an IPad® screen. The issue of whether tactile tablets are actually useful tools for children with grapho-motor and pencil holding difficulties is still open. The next step of this work-in-progress is to increase our sample size in order to collect additional data and to conclude more definitely on the usability of tactile tablets for promoting drawing activity by Down syndrome children.

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