MANUAL WRITING AND DIGITAL WRITING. GRAPHO-MOTOR ASSESSMENT STRATEGIES AND RESEARCH PERSPECTIVE

SCRITTURA MANUALE E SCRITTURA DIGITALE. STRATEGIE DI VALUTAZIONE GRAFOMOTORIA E PROSPETTIVE DI RICERCA

Rosanna Perrone
Università degli Studi di Salerno
rperrone@unisa.it

Lucia Pallonetto
Università degli Studi di Salerno
lpallonetto@unisa.it

Valeria Minghelli
Università degli Studi di Salerno
vminghelli@unisa.it

Carmen Palumbo
Università degli Studi di Salerno
capalumbo@unisa.it

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ABSTRACT
In the Fourth Educational Revolution, there was an increase in digital writing and a reduction in manual writing in schools. The aim of the survey was to evaluate the graph-motor skills of the students involved in the study, in order to verify the results of a treatment program that included, for the experimental group, a playful-motor laboratory (Jeannot, 1976). The survey showed results of improvement, both in terms of quality and speed of writing, more evident for the experimental group.

Nella IV rivoluzione educativa si registrano, in ambito scolastico, l'aumento della scrittura digitale e la riduzione di quella manuale. L'indagine ha avuto l'obiettivo di valutare le abilità grafo-motorie degli allievi coinvolti nello studio, per verificare gli esiti di un programma di trattamento che ha previsto, per il gruppo sperimentale, un laboratorio ludico-motorio (Jeannot, 1976). Dall'indagine sono emersi risultati di miglioramento, sia in termini di qualità che di velocità di scrittura, maggiormente riscontrabili per il gruppo sperimentale.

KEYWORDS
digital writing; manual writing; motor assessment; corporeality; primary school
scrittura digitale; scrittura manuale; valutazione motoria; corporeità; scuola primaria

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Introduction

The fourth wave of technology development attributes a leading role to the media (Rivoltella, 2023), responsible for a radical change not only in communication processes, but also in learning processes: "the media have migrated within our lives" (Bell, 2002 cit. in idem, p. 65). In this new educational scenario, the ways of accessing to knowledge for post-millennials (Iavarone, 2022), or the *newest* of the *digital natives* (Prensky, 2001), have profoundly changed. Thanks to digital technologies, the processes of information and "training" of the individual are undoubtedly faster. This acceleration, far from being a simplification of the process, describes, instead, its profound complexity.

Considerations in the educational field around training and learning processes for the child, the main protagonist of this paradigmatic inversion, require an adult culture capable of raising awareness of a *digital wisdom*, which corresponds to a competent, responsible, and conscious use of the new technologies, both at home and at school (Prensky, 2013).

In parallel, in the fourth educational revolution (Seldon & Abidoye, 2018) that permeates the school landscape, there is an inverse proportionality between the increase in digital writing and the decrease in manual writing. The phenomenon of digitization of writing is steadily increasing, and according to the most recent international and national literature, there is at the same time a worrying loss of manual writing among young students, especially in cursive form, as well as an increasing percentage of cases with writing difficulties and/or dysgraphia (Di Brina et al., 2022).

The difficulty in manual writing is present since primary school, where there is a decrease in the use of cursive and a preference for using capital letters or script. A study that investigated the legibility of primary school children's writing (Loizzo, 2023). Validation of the concise assessment scale for children's handwriting (BHK) in an Italian population. Children, 10(2), 223.) highlighted that the 21.6 % of them are at risk of developing manual writing problems, in fact, one in five children may have specific difficulties writing in cursive. Also in the international context, studies have led to the approval of a bill (no. 446/2023) that would impose the teaching and use of cursive from grade one to grade six (6 to 12 years old).

In this scenario, in which the grapho-motor exercise is likely to be significantly reduced, the authors (Coluccia, 2020) call for the preservation of the manual writing process, especially at a developmental age and, at the same time, for an integrated and consciously implemented use of digital and manual writing in teaching practices (Travaglini, 2022). The *Accademia della Crusca* expresses concern about the progressive decline of manual writing and, at the same time,

urges the preservation of its use, with special attention to the cursive form. This call does not discredit the use of digital writing but emphasizes how digital writing and manual writing must go together without one replacing the other. “Old and new can coexist, they are not in conflict, one does not exclude the other [...]” (Coluccia, 2020). The increase in difficulty recorded in learning processes invites us to consider how much the way the child writes words on the paper represents the fruit of his or her experiences of movement in the environment, especially when referring to the post-millennial’s generation.

The challenge is thus to preserve the skill of writing, a fundamental activity in learning processes. Marginalizing manual writing means excluding the body from teaching practices. Instead, the body represents the key to all experiences. The literature well clarifies how learning, especially in childhood, originates in doing, within a full and meaningful motor involvement, much more in concreteness than in abstraction (Oliverio, 2017).

Considering how much, in learning processes, the body in action, as a founding vehicle of multiple learning, favors the subject's global and harmonious development (MIUR, 2011), the aim of the study was to evaluate grapho-motor skills in developmental age through the use of the BHK scale (Di Brina & Rossini, 2021) to investigate the effects of a play-motor workshop aimed at improving and increasing the development of graphic skills. In the light of scientific literature, the motor laboratory (Sibilio, 2007) was structured according to the Jeannot method (1976), already known and also used in the clinical context of occupational therapy (Lefevere & CHU recommended, 2006), particularly in relation to the treatment of cases of dyspraxia and dysgraphia (Mazeau et al., 2016; Beaussart & Mayer, 2015), as this is considered to be able to positively influence the development of graph- from the promotion of greater body awareness.

1. **Manual writing and digital writing**

The literature has long affirmed that, in all learning processes, the activation of one of the components of being (cognitive, bodily, emotional) implies, simultaneously, the involvement of all the others and that this co-activation and co-evolution is mutually reinforcing the outcomes of the process itself (Caruana & Borghi, 2016). Similarly, in the act of writing, sense-perceptual skills, together with motor skills, give rise to the refined praxis of writing (Mangen & Velay, 2010). Manual writing, far from being a merely cognitive process, requires a neuromotor integration in which cognitive, perceptual and active dimensions participate simultaneously in a

creative act. Digital writing, unlike manual writing, requires less complex movements.

In terms of organization of the movement, keyboard typing involves a completely different orientation of the hand. The graphic gesture requires the ability to master both motor and perceptual skills, as well as cognitive ones (Rigal, 2009; Zesiger, 1995 cit. in Angelini, 2014). In it, haptic perception plays a fundamental role in the exploratory movement of the hand and the manipulation of objects. On the contrary, digital writing does not require the organization of a specific sequence of movements preparatory to the creation of the graphic, fluid and continuous stroke but involves the organization of discrete movements, and the finger-key correspondence does not require that the principle of bi-univocal correspondence be respected, so that the typing of a letter can be carried out equivalently by different fingers of the hand (Mangen & Velay, 2010).

Handwriting is the result of a finely elaborated neuro-motor program, which requires the recruitment of basic skills such as neuro-motor maturation, harmonious muscle tone development and high motor control. The action of writing is given by a union of movements that generates graphic signs endowed with a precise sound and semantic value as well as characterized by specific expressions of meaning (Olivaux, 2014). The regulation of muscle tone, moreover, allows the arm segments to be stationary and at the same time flexible to allow the hand to perform the flexion-extension and abduction-adduction movements (Zesiger et al. 1995), which ensures fluidity for a precise and tremor-free stroke. The graphic gesture is, therefore, characterized by high anatomical complexity and requires the simultaneous control of a large number of joints (Galeno, 1996). Manual writing represents a task in which what Bernstein (1967) called *motor equivalence* is realized, referring to situations in which the same result is the result of very different movements. Raibert (1997) shows that people can write with a consistent style even when using different effectors (cit. in Vastola, 2013). This variability of movement, in relation to the force exerted, speed, amplitude and size (Wing, 1980), requires a motor competence that does not coincide exclusively with the correct execution of the motor program implied to the writing, but also with a discrete flexibility, in terms of coordination, that allows the achievement of the result in situations that are always variable (of the subject and the environment).

Even the motor functions, far from being exclusively the result of a perceptive and kinesthetic organization, are the outcome of processes of internalization and space-time structuring, in which the graphic stroke becomes an expression of the child's psychosomatic unity, just think about the natural evolution that occurs in the passage from doodling to drawing to the graphic symbol. Doodling first, drawing

later and writing, are to be considered real “languages” that in their spontaneous form manifest the characteristics of the young individual's temperament and its maturation through the evolution of the graphic language itself.

The evolutionary pathway includes the stages and progress of self-awareness and bodily experimentation, as well as the relationship between the organizational movement of writing and the education received from the environment. Manual writing, therefore, is never random, but always connected to the individual's innate structure and personal history. Digital writing, on the other hand, would appear to be more impersonal and less connected to a real involvement of corporeality (Natta, 2016). The graphic-scriptural action represents a specific expression, both symbolic and narrative, that relates the child to its representation of the world, and therefore fulfils two functions: informing and communicating (Travaglini, 2021; 2022). Whereas manual writing is rich in metacognition elements, in which it is possible to “read between the lines”, digital writing does not provide any feedback about the exerted pressure, the coordinative dynamics implied to the execution, or the space-time knowledge. In brief, manual writing, in requiring the recruitment of different and complex motor patterns, also allows for their reading, a reverse decipherment action that allows for an equally holistic assessment of the author's skills. The literature on the use of manual writing reports advantages that affect all areas of the individual's development. It is able to stimulate bodily-kinesthetic (Gardner & Hatch, 1989) and emotional intelligence (Goleman, 2011); it stimulates greater brain connectivity between the various encephalic areas, more than keyboard writing (Ose Askvik, et al, 2020); it promotes orthography accuracy and consolidates memory (Longcamp et al.,2008), improves vocabulary and syntax (Vertecchi, 2016), positively influencing the language area (Berninger, et al.,2016).

Today, manual writing skills risk being highly compromised, and for this reason it is necessary, and this is the aim of this work, to initiate intervention and investigation measures aimed at not losing the complexity implied to the act of writing, the experiential contribution of which is undeniable, and at imagining possible scenarios of integration between this and the complexity underlying the process of mediation underway, the *extended* nature of which is undeniable, which also favors the exploration of infinite experiential and imaginative levels.

2. Methods

2.1 Objective

Through the use of the BHK scale, a synthetic scale for the evaluation of writing in developmental age (Di Brina & Rossini, 2021), the quasi-experimental investigation aimed at assessing the pupils' grapho-motor skills in order to investigate the effects of a treatment program that included the introduction of a play-motor workshop, declined according to the Jeannot method (1976) aimed at promoting the acquisition of greater motor awareness, through sensory-perceptive games and general dynamic coordination aimed at increasing the development of graphic skills, through the promotion of greater body awareness.

2.2 Sample

The research involved a convenience sample of 200 children (M=96; F=104), (Tab.1) attending the third and fourth classes of primary school, aged between 8 and 9 years (Tab.2) selected by non-probabilistic sampling.

		Freq	%
Valid	**F**	104	52,0
	M	96	48,0
	Total	200	100,0

Tab 1. Gender frequency of the total sample

		Freq	%
Valid	**8**	113	56,5
	9	87	43,5
	Total	200	100,0

Tab 2. Age frequency of the total sample

2.3 Methodological procedures and research tools

For this study, a quasi-experimental research project was implemented (Trinchero, 2017), for which it was not possible to check all factors: from the manipulation of the dependent variable (dependent variable y = the grapho-motor skills, which cannot be completely manipulated), to the independent factors (independent variable x = experimental stimulus - playful motor workshop) to intervening factors (such as possible disruptive factors, for example other movement activities). The sample was divided into two groups: the first, the control one (No. 108) which was not subjected to any extra activities compared to the curricular ones of Physical Education and the other, experimental one (No. 92), the latter consisting of the students involved in the processing activities (Aiello, 2012), specifically, playful-motor workshop structured according to the Jeannot method, the implementation of which was carried out by the authors of the present study.
The trial was conducted in a month and a half and involved the structuring of 9 meetings lasting one hour each, organized according to levels of increasing complexity, which aimed to stimulate the translation of visual-perceptual information into bodily productions.

Jeannot method

The Jeannot Method represents a holistic approach to teaching of reading and writing that emphasizes the importance of sensory experience and movement in the learning process.
The activities aim at promoting the learning of the directionality of gesture to write in cursive (Di Dona et al., 2019) starting from the structuring of situations of symbolic play and co-construction of body movements suitable for representing linguistic utterances. In each meeting, children were asked to reproduce stylized figures presented to them, through a creative and expressive use of the body (Olivaux, 2014), at first in a segmental manner and then in a global one (Neri, 2005). The activities allowed the children, starting with the use of each child's personal kinaesthetic memory (Bergonzoni, 2016), to explore new bodily, expressive and communicative dimensions of the contents of the verbalizations. In continuity with the principles of the method, the meetings included a gradual progression, in which they started from basic skills arriving at building more complex skills, involving segmental and global body.

BHK Scale

The scale *BHK - Synthetic Scale for the Assessment of Writing in Developmental Age* allows the assessment of the graphic stroke in elementary school children. The version used for this trial is an Italian adaptation of a Dutch test developed by Hamstra-Bletz, De Bie and Den Brinker (1987). The test involves the transcription in cursive form of a short text, to be completed in a predetermined time, communicated in advance to the children, of 5 minutes. The text has an increasing complexity so that starting from words with a simple syllabic structure one arrives at an increasingly complex articulation. The transcription should be done on a completely blank sheet of paper, without preset lines, on which the child should coordinate his or her graphic gesture in the space of the paper without visual references, taking full advantage of his or her coordinative skills, fluency and accuracy in writing. For the assessment, it is necessary for the child to have completed at least the transcription of the first five lines, with reference to which the quality of writing is assessed. The scale considers the assessment of 13 parameters grouped into three areas of observation: Spatial Organization (ORG), Motricity (MOT), and Grapheme Form (FOR). For speed, the number of characters written correctly in the 5-minute time is considered.

3. **Data Analysis**

The results were computerized and organized in an Excel environment, converted into standardized scores as provided by the BHK test (Di Brina & Rossini, 2021). The organization of the collected scores, in Excel data matrix, allowed comparison with normative data, for age and gender variables. The collected data were analysed using SPSS26 statistical software.
The complete data set was subsequently subjected to:

- frequency distribution of BHK categories (writing quality) T0-T1 on the total sample (Tab.3);
- contingency tables for comparison of BHK categories, when comparing experimental and control group pre- and post-laboratory (T0-T1) (Tab.4);
- descriptive statistics, with mean and standard deviation for T0-T1 writing speed over the whole sample (Tab.5);
- comparison of averages and SD of T0-T1 writing speed with groups subdivision (Tab.6).

3.1 Results and Discussions

Comparison of the frequencies of BHK T0-T1 categories on total sample, with reference to writing quality, shows better results in the second administration of the test on the total sample (Tab. 3). From the comparison between groups, experimental and control, the contingency tables report improved values for the experimental group (Tab. 4). Specifically, for the experimental group alone, the expert category decreases from 66 to 76 cases (from a percentage of 71.7% to one of 82.6%); the borderline category decreases from 19 to 12 cases (from a percentage of 20.7%, to one of 13%); and finally, cases in the dysgraphic category decrease from 7 to 4 (from a percentage of 7.6% to one of 4.3%).

T0_categories_BHK		Freq	%
	Expert	147	73,5
	Borderline	32	16,0
	Dysgraphic	21	10,5
	Total	200	100,0
T1_categories_BHK		Freq	%
	Expert	157	78,5
	Borderline	30	15,0
	Dysgraphic	13	6,5
	Total	200	100,0

Table 3. Frequency comparison of BHK T0-T1 categories on the total sample

			T0_ categories _BHK			Total
			expert	Borderline	dysgraphic	
groups	control group	Counting	81	13	14	108
		%	75,0%	12,0%	13,0%	100,0%
	experimental group	Counting	66	19	7	92
		%	71,7%	20,7%	7,6%	100,0%
Total		Counting	147	32	21	200
		%	73,5%	16,0%	10,5%	100,0%

			T1_ categories BHK			Total
			expert	borderline	dysgraphic	
groups	control group	Counting	81	18	9	108
		%	75,0%	16,7%	8,3%	100,0%
	experimental group	Counting	76	12	4	92
		%	82,6%	13,0%	4,3%	100,0%
Total		Counting	157	30	13	200
		%	78,5%	15,0%	6,5%	100,0%

Table 4. Contingency tables of BHK categories with subdivision of group (experimental and control), T0-T1

In relation to writing speed, improvement results emerge against the total sample (tab. 5) when comparing T0 (M= 182.67) and T1 (M= 223.81) administrations. However, in this case, the improvement values are fairly evenly distributed when comparing between groups (tab. 6). Specifically, the control group goes from a mean T0 of M=184.05 to a mean T1 of M=224.04; similarly, the experimental group shows similar improvement in going from a mean T0 M=181.04 to a mean T1 of M=223.54.

	N	Media	Standard dev
T0_ writing_speed	200	182,67	44,18
T1_ writing_speed	200	223,81	69,28
Valid (listwise)	200		

Table 5. Descriptive analysis means and standard deviation Writing speed on total sample

Groups		T0_ writing speed	T1_ writing speed
control group	Media	184,05	224,04
	N	108	108
	Standard dev.	44,14	75,21
experimental group	Media	181,04	223,54
	N	92	92
	Standard dev	44,40	62,00
Total	Media	182,67	223,81
	N	200	200
	Standard dev	44,18	69,28

Table 6. Comparison of averages and SD of T0-T1 writing speed with groups subdivision

At last, according to the normative values, in relation to the quality of writing, this seems to be more dependent on the "gender" factor with more positive values for females; while, in reference to writing speed, this is in direct proportion to the growth of the subjects and the "gender" factor does not seem to influence graphemic production. From the emerged data, it's possible to state that the playful-motor activities, structured according to a specific methodology aimed at encouraging the exploration of the graphic stroke through experiences of body movement in space, favored, for the experimental group, the achievement of better results, especially with reference to writing quality. It is possible to suppose that the motor-expressive and playful activities, although not perfectly "isolable" from other possible intervening factors (which, however, would have affected both groups), provided an opportunity for repeated and refined exploration of the body in space, which fostered the development of a motor memory, enabling the child to write fluidly and accurately, coordinating more effectively the curvilinear and rotational movements preparatory to the written stroke.

Conclusions

In compliance with the scientific literature, the study confirms the need to preserve the use of cursive, which does not only involve the activation of a mental process but, unlike digital writing, requires "the integration of visual, proprioceptive (haptic and kinesthetic) and tactile data" that develop along two matrices, perceptual and graphomotor (Natta, 2016, p. 28). Knowing how to hold a pencil involves the entire body and senses in an intricate, multisensory process; its orientation on the paper involves a motor act closely connected to complex cognitive processes. Learning to write by hand represents a complex process involving motor coordination, global and segmental, sequential memory and sensory feedback.

Motor theories of perception highlight how closely writing is linked to the active exploration of the surrounding environment through a complex interaction of the senses. In this sense, playful-motor workshops, through the implementation of preparatory, directional and form movements of writing (Neri, 2005), movement games structured in such a way as to enhance bodily awareness (Olivaux, 2014), would seem to have enabled an enhancement of the perceptual, exploratory and creative components of the body, fostering a transfer of skills from the environment to the paper. The study is in continuity with what is present in the literature, about the effects of prolonged use of technological tools that modify hand movements and the act of writing (Natta, 2016), considerably impacting space-time organization and motor control.

The risk underlying the massive use of technological devices consists in the progressive loss of the fluidity of the graphic stroke that occurs, far from being able to be interpreted as an increase in cases of dysgraphia in the population (Di Brina et al., 2022), refers much more likely to a loss of gestural expressiveness, which is also underlying the writing movement. Losing gestural expressiveness, means reducing control and giving up that attention placed on subtle movements, with inevitable consequences on the very ability to learn. In the educational and pedagogical sphere, it is essential to continue to consider the body in action as an indispensable tool in the dialogue with the environment, capable of fostering the natural transition from motor skills to those of abstraction and representation.

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