



PSYCHOMOTOR AND RHYTHMIC EDUCATION AS AN INTERVENTION FOR OPTIMIZING READING AND HANDWRITING READINESS IN KINDERGARTEN

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Abstract:

Introduction: Handwriting readiness is a key indicator of school readiness in early preschool age, as it is directly linked to academic performance, the child's self-concept and their participation in the learning process. Modern developmental and pedagogical approaches recognize that writing is not an isolated skill, but rather emerges through the cooperation of psychomotor, visuomotor, and rhythmic functions. **Purpose:** To investigate the effect of a structured psychomotor and rhythmic intervention on the handwriting readiness of preschool children. **Methodology:** The research was based on

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an experimental design with an intervention group and a control group and repeated measurements before and after the implementation of the program. The intervention group participated in a program of psychomotor and rhythmic activities that aimed to enhance fine motor skills, eye-hand coordination, and temporal organization. **Results:** The findings showed a significant advantage of the experimental group across all indicators of psychomotor and handwriting development, along with very large effect sizes. Improvements were observed in fine motor skills, eye-hand coordination, spatiotemporal organization, and overall handwriting readiness. **Conclusions:** The findings indicate that psychomotor and rhythmic education constitute an effective intervention for enhancing handwriting readiness in early preschool education. The integration of such programs into the kindergarten curriculum can act preventively and supportively for future school learning.

Keywords: handwriting readiness, psychomotor education, rhythm, fine motor skills, eye-hand coordination, preschool education

1. Introduction

Handwriting readiness is a critical indicator of school readiness in preschool, as it is directly associated with later academic achievement, participation in the learning process, and the child's self-perception as a student (Sheedy *et al.*, 2021). A child's ability to control the hand with precision, coordinate vision with movement, and organize their graphic actions in time is a prerequisite for the transition from early pre-writing activities to functional writing. Modern literature recognizes that writing is not an autonomous skill, but a complex system grounded in multiple cognitive, motor, and executive functions that gradually develop during the preschool years (Dinehart, 2015).

The writing process relies on the cooperation of visuomotor, fine motor and executive mechanisms, which allow the child to represent symbols on paper with accuracy, stability, and temporal control. The production of written symbols requires not only knowledge of letters, but also the child's ability to control pressure, direction, sequence, and the rhythmicity of movements. Writing is, therefore, a highly complex visuomotor skill which does not mature automatically but is shaped through the child's development and experience with bodily and sensory stimuli (Priyadi *et al.*, 2024).

The concept of handwriting readiness refers to the skills that precede the formal learning of writing and includes fine motor skills, eye-hand coordination, the ability to handle tools, the direction and stability of movement, as well as the temporal organization of graphic actions. International literature shows that children with developed handwriting readiness skills have a greater likelihood of acquiring legible, stable, and functional writing, while deficiencies in these skills are associated with difficulties in school adaptation and an increased risk of learning difficulties (Achymy *et al.*, 2022).

A particularly important factor in the development of handwriting readiness is fine motor skills, which allow the child to control the grip, accuracy and stability of the writing tool. The ability to manipulate small objects, finger precision, and in-hand manipulation skills are directly related to the quality and legibility of writing. Research in preschool populations shows that fine motor accuracy and in-hand manipulation skills strongly predict letter clarity and stability of letter formation, highlighting the importance of motor maturation before the onset of systematic writing (Seo, 2018; Chandler *et al.*, 2021).

Along with fine motor skills, hand-eye coordination constitutes a central component of handwriting readiness. The child is required to match visual patterns with motor actions, control the course of the line and maintain the correct spatial arrangement of graphic elements. This ability is associated with accuracy in copying shapes and letters, as well as with the stability of writing in the space of the paper. It has been found that children with better hand-eye coordination show higher levels of graphomotor proficiency and better academic readiness (Dinehart, 2015; Lu *et al.*, 2024).

Beyond purely motor and visuomotor skills, the temporal organization and rhythm of movement constitute key mechanisms in the development of writing. Writing is not a simply static skill, but a sequential motor act that requires precision in timing, stability in flow and the ability to synchronize the small movements of the hand. Research shows that rhythm and synchronization ability influence pencil pressure, line smoothness and the overall quality of handwriting, suggesting that rhythmic and musical-motor experiences can function as mechanisms for organizing graphomotor performance (Williams *et al.*, 2020; Williams *et al.*, 2023; Priyadi *et al.*, 2024).

Psychomotor and rhythmic education provides a particularly suitable framework for enhancing these skills, as it combines bodily movement, spatial organization, rhythm and conscious use of the body. Through psychomotor activities, children learn to control posture, stability, and the small movements of their limbs, while rhythm functions as an external organizer of movement and attention. These processes are directly related to the requirements of writing, which require precision, stability, and temporal coherence in hand movements (Priyadi *et al.*, 2024).

Modern literature confirms that handwriting readiness is not formed only through repetitive writing exercises, but through a broader framework of sensory and motor maturation (Butler *et al.*, 2019). Interventions that include finger-play activities, object manipulation, painting, construction tasks, and rhythmic movement have been associated with improvements in fine motor skills, hand-eye coordination, and overall writing proficiency. These activities act as pre-writing stimuli that prepare the neuromotor system for the demands of writing (Achymy *et al.*, 2022).

Of particular importance is the fact that handwriting readiness is associated not only with the mechanical aspect of writing, but also with the child's general school and emotional adjustment. Difficulties in writing have been associated with lower self-esteem, avoidance of written activities, and increased anxiety in the school environment. In contrast, adequate preparation of children for the demands of writing may serve a

protective effect, enhancing self-confidence and a positive attitude toward learning (Dinehart, 2015).

Despite the importance of handwriting readiness, the literature points out that it is often underestimated or treated in a fragmented manner in early childhood education (Lopez-Escribano *et al.*, 2022). Many programs focus primarily on the cognitive dimension of writing, such as letter recognition, while neglecting the motor and sensory mechanisms that make the functional production of written symbols possible. However, research indicates that writing is primarily a visuomotor skill that requires systematic preparation through movement, rhythm, and sensory integration (Achymy *et al.*, 2022; Priyadi *et al.*, 2024).

Based on the above, the purpose of the present study was to investigate the effect of a structured psychomotor and rhythmic education intervention on the handwriting readiness of preschool children. The study aimed to examine whether the systematic exposure of toddlers to activities that combine rhythm, movement, and fine motor activation could lead to improvements in fine motor skills, eye-hand coordination, temporal organization, and overall handwriting readiness, factors that the international literature identifies as critical for the development of functional writing in early school age (Dinehart, 2015; Seo, 2018; Achymy *et al.*, 2022; Priyadi *et al.*, 2024).

2. Material and Methods

2.1 Design of the Intervention

The experimental program, which was carried out in the form of a structured psychomotor and rhythmic education intervention, had as its main objective the improvement of the graphomotor readiness of preschool children. A total of 25 intervention sessions were conducted, each lasting 45 minutes and were delivered exclusively to the experimental group, twice a week, over a total period of 12 weeks. Through this specific period of time, it was possible to gradually cultivate the psychomotor and rhythmic skills of the children following a progressive increase in the difficulty of the activities, from simpler to more complex and demanding.

2.2 Program Objectives

The experimental program was created based on the developmental characteristics of preschool children, especially in terms of body shape, lateralization, spatial and temporal organization, as well as psychosocial factors related to the acquisition of writing. Therefore, the three main axes were essentially included. The first concerns body control, so as to improve writing posture, fine motor skills, as well as grip and visuomotor coordination of children. The second axis concerns the study of spatial concepts through the awareness of graphic space. The third and final axis is linked to the cultivation of temporal organization and concerns rhythm, duration, and sequence.

2.3 Structure and Organization of the Sessions

Each intervention includes three distinct phases. The first phase is the preparation phase, where there are activities for free physical expression and discovery. The second phase mainly includes directed psychomotor and rhythmic activities, which aim at improving specific skills. The third and final phase is the relaxation phase, where there are breathing exercises, stretching, and some graphic representation activities through which the transition from bodily action to mental processing can be effectively supported.

2.4 Types of Activities and Teaching Principles

The organization of the activities was carried out based on the progressiveness of the difficulty. At the same time, three main types of activities are included. First, there are activities of free exploration and discovery. Next are the guided activities, which aim to improve psychomotor skills. Finally, there are also graphic representation activities so as to enhance the internalization and mental organization of movement itself. In the present program, greater emphasis was placed on the connection between movement and rhythm, while a gradual transition was also made from general motor experience to writing.

2.5 Materials and Organizational Format

The program was implemented mainly on an individual basis or in pairs, while at the same time, small and flexible materials were used, such as balls, balloons, scarves, rods, plasticine, ribbons, and appropriate writing tools. In this way, a high level of participation was ensured, while the pace of development of each child individually was appropriately supported. In addition, the visual, auditory and kinesthetic perception of the children was enhanced overall.

2.6 Thematic Sections of the Program

At the same time, there were three sections during the program, divided into different themes. The first section focused on the awareness of body shape, the second on the acquisition of spatial organization, and the third on the mastery of temporal organization. At the same time, rhythm was the axis that connected the three phases, as well as physical movement with the coordination and the skills that preschool children need to develop.)

3. Results

Regarding the students' performance before the intervention, there was no statistically significant difference in the total psychomotor skills, which suggests that the groups start with equal and comparable measures. However, after the intervention, it appears that the experimental group displays a higher level of total psychomotor skills and, more specifically, it displays higher performance in terms of fine motor skills, total score for temporal organization and the knowledge of the concept of rhythm, which are

particularly strengthened after the intervention. Therefore, it appears that these skills are directly to the general graphomotor readiness of the children.

Table 1: Psychomotor performance (before-after)
 by group and control of differences between group

Variable	Time	Experimental group, M (SD)	Control group, M (SD)	t(df)	p
Fine motor ability	Before	13.68 (2.585)	14.38 (3.377)	-1.266 (114)	.208
	After	18.92 (2.165)	15.48 (3.247)	6.818 (114)	< .001
Total score for temporal organization	Before	12.91 (3.914)	12.92 (4.353)	-0.019 (114)	.985
	After	19.42 (2.756)	14.73 (4.374)	7.007 (114)	< .001
Knowledge of the concept of rhythm	Before	5.70 (2.423)	5.43 (2.500)	0.587 (114)	.559
	After	9.08 (1.479)	6.27 (2.457)	7.577 (114)	< .001
Total psychomotor score	Before	69.77 (13.433)	71.92 (16.158)	-0.781 (114)	.436
	After	103.42 (9.530)	79.37 (15.357)	10.295 (114)	< .001

At the same time, Table 2 shows that before the intervention, there are no statistically significant differences between the experimental group and the control group regarding the graphomotor performance. However, after the intervention, it emerges that the experimental group displays a statistically significantly higher level of total graphomotor performance, but also that it displays a higher level in terms of knowledge of the graphic code, knowledge of graphic space, and visuomotor coordination, compared with the control group.

Table 2: Handwriting performance (before-after)
 by group and control of differences between groups

Variable	Time	Experimental group, M (SD)	Control group, M (SD)	t(df)	p
Visuomotor coordination	Before	5.43 (2.469)	4.67 (2.349)	1.712 (114)	.090
	After	8.70 (1.793)	6.76 (2.474)	4.874 (114)	< .001
Knowledge of graphic space	Before	2.98 (1.845)	3.22 (1.689)	-0.734 (114)	.464
	After	5.25 (1.142)	3.83 (1.661)	5.429 (114)	< .001
Knowledge of graphic code	Before	3.74 (2.021)	3.56 (2.220)	0.454 (114)	.651
	After	6.32 (1.554)	4.81 (1.865)	4.686 (114)	< .001
Total handwriting score	Before	12.15 (5.329)	11.44 (5.035)	0.733 (114)	.465
	After	20.26 (3.235)	15.40 (4.774)	6.508 (114)	< .001

The comparison conducted before and after the intervention program shows that there are significant improvements in the group that participated in the program, both in terms of overall psychomotor development and overall graphomotor readiness and rhythmic organization. More specifically, it seems that the greatest effect of the intervention was recorded in the overall level of psychomotor performance (Cohen's $d \approx 1.93$). Therefore, it seems that the program had a catalytic role in the overall level of functional maturation of the children. At the same time, in terms of fine motor skills ($d \approx 1.28$), temporal organization ($d \approx 1.31$), rhythm and the concept of rhythm ($d \approx 1.42$), high-level effects

were also presented making these variables important for the development of writing skills. Additionally, visuomotor coordination ($d \approx 0.91$) and the overall level of graphomotor performance ($d \approx 1.22$) show a high-level to very high-level effect, highlighting that the psychomotor and rhythmic intervention contribute substantially to the functional readiness of children for writing. Based on the above findings, the intervention program appears to have had a significant effect on the school readiness of preschool children.

Table 3: Effect measures (Cohen's d) for basic psychomotor and handwriting skills after the intervention

Variable	t(df)	p	Cohen's d	Effect size magnitude
Total psychomotor score	10.295 (114)	< .001	1.93	Very large
Fine motor skills	6.818 (114)	< .001	1.28	Very large
Total score for temporal organization	7.007 (114)	< .001	1.31	Very large
Knowledge of the concept of rhythm	7.577 (114)	< .001	1.42	Very large
Visuomotor coordination	4.874 (114)	< .001	0.91	Large
Total handwriting score	6.508 (114)	< .001	1.22	Very large

4. Discussion

Through this study, it was demonstrated that the use of a structured psychomotor and rhythmic education program can contribute to the improvement of graphomotor readiness in kindergarten and preschool children. The findings of the research showed that the cultivation of body control, fine motor skills, spatiotemporal organization, and rhythm led to improvements in pre-writing skills, such as visuomotor coordination, understanding of graphic space, and the overall organization of graphic movement.

The study also revealed that the experimental group showed a higher average level and performance across all indicators of psychomotor and graphomotor development, as well as very large effect sizes. Therefore, it seems that the intervention had both a statistical and substantive pedagogical effect. More specifically, it emerged that rhythm is the primary mechanism through which movement and temporal sequence are linked to stability and control, elements that are very important for the transition of preschool children from bodily action to writing (Williams, 2018; Williams & Berthelsen, 2019).

Additionally, the findings of the study emphasize that graphomotor readiness is linked to both psychomotor and rhythmic functions (Gil-Moreno & Rico-González, 2023). Therefore, organized programs that focus on psychomotor and rhythmic education, as well as the integration of such methods into the kindergarten curriculum, are essential

for the prevention of potential writing difficulties. At the same time, they could contribute to the establishment of a stable foundation for learning more broadly.

In conclusion, the present study highlighted that school education should treat writing as a skill which is influenced by multiple factors (Slot *et al.*, 2017). At the same time, it should lay the foundation for understanding of body movements, rhythm, and the general spatiotemporal organization, both as a whole and as an early form of practice related to graphic symbols.

The above findings are consistent with the modern understanding that graphomotor readiness is not a strictly graphic skill, but a product of the interaction of motor, sensory, and executive functions. International literature supports that the development of writing is based on fine motor skills, visuomotor coordination, and temporal organization of movement, which constitute fundamental mechanisms for the production of stable and legible written symbols (Achymy *et al.*, 2022).

In particular, the marked improvement in fine motor skills and visuomotor coordination recorded in the present study constitutes a central finding, as these skills have been recognized as key predictors of handwriting quality. Research in preschool populations shows that finger accuracy, object manipulation skills, and in-hand manipulation abilities are directly associated with the clarity and stability of letter formation, confirming that improvement in these mechanisms may lead to a substantial enhancement of graphomotor performance (Seo, 2018).

The emergence of rhythm as a central mechanism in the present study is also consistent with the international literature, which shows that the temporal organization of movement directly affects the stability, flow, and control of the graphic act. Writing requires precise synchronization of small movements, stability in pressure, and the ability to maintain movement within predetermined temporal and spatial boundaries. Rhythm functions as an external and internal regulator of these processes, facilitating the transition from generalized bodily movement to fine graphic action (Priyadi *et al.*, 2024).

Additionally, the association between graphomotor readiness and psychomotor development confirms that writing emerges from a broader framework of bodily and sensory control. Psychomotor education through activities that enhance trunk stability, spatial awareness, and upper-limb control creates the foundations on which fine motor control of the hand is built. Thus, the improvement in psychomotor indicators recorded in the present study may be interpreted as a key mechanism supporting children's graphic maturation (Achymy *et al.*, 2022; Dinehart, 2015).

The pedagogical dimension of the findings is also important, as the increase in graphomotor readiness is not limited to the improvement of writing technique, but also affects children's school self-perception and participation in the learning process. It has been found that children who possess adequate graphomotor skills experience less frustration, demonstrate greater self-confidence, and participate more actively in writing activities at school, which enhances their overall school adjustment (Dinehart, 2015).

Overall, the results of the present study reinforce the scientific argument that graphomotor readiness should be viewed as a developmental skill that is cultivated

through bodily experience, rhythm, and organized movement. Psychomotor and rhythmic education appears to provide a particularly effective framework for prevention and early support, which may reduce the risk of writing difficulties and lay solid foundations for children's school learning in primary education.)

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Conflict of Interest Statement

The authors declare no conflicts of interest.

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