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Neuropedagogy in the Development of Skills Initials of Reading and Writing

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Abstract

The research project, called "Neuropedagogy in the Development of Initial Literacy Skills," had a mixed approach (quantitative and qualitative). The objective was to determine the potential of neuropedagogy as a methodological tool for improving the development of initial literacy skills in high school children at the Matilde Hidalgo de Procel Educational Unit in the city of Santo Domingo, province of Tsáchilas. The procedural methods used were bibliographic, inductive, deductive, and descriptive. A correlational level of research was also determined, and the methodological design was quasi-experimental. The population consisted of high school teachers and students from the Educational Unit. The sample the study consisted of two groups of 10 high school students, each comprising the control and experimental groups. The information collected was based on the implementation of a pre- and post-test based on strategies related to neuropedagogy oriented to the development of initial reading and writing skills. Finally, the hypotheses posed were Ha = Strategies based on neuropedagogy develop initial reading and writing skills in high school students and Ho = Strategies based on neuropedagogy do not develop initial reading and writing skills in high school students.

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1 Introduction

Without a doubt, one of the most important tasks of a teacher is teaching reading and writing to high school children, lessons that will forever shape their future. Therefore, early childhood education is considered a level of education where objectives are met in the social, intellectual, emotional, and motor areas, all of which are closely related to preparing children for regular schooling.

The constant evolution of society forces teachers to ask new questions about how to approach this task. These questions are related to their work, answering questions such as: What strategies should be used to develop prewriting skills in 4-year-olds? How can parents be included in the educational process? And how can children be motivated to learn to write? Answering these questions is not an easy task, nor does it fall to a single person. It requires a collaborative effort among all involved to achieve the objectives (Bartlett, 2008).

Understanding, interpreting, and using a text is not only an indispensable condition for completing compulsory schooling, but also for functioning in everyday life in literate societies. From our perspective, teaching reading to schoolchildren is undoubtedly a noble endeavor; it constitutes a fundamental tool for academic development and, therefore, for the future of our children (Solé, 1987)

The fundamental purpose of this research was to propose the implementation of strategies related to neuropedagogy in the development of initial reading and writing skills in 4-year-old children. As well as including strategies related to the Neuropedagogy of the Plastic Arts, through the manipulation of modeling clay, children were able to create their figurines based on letter associations through the use of neuropedagogy strategies, so that children can develop initial reading and writing skills. The purpose of this research was to characterize a figurine based on letter associations to strengthen fine motor skills and interpretation in children (Hämäläinen & Vähäsantanen, 2011).

The research approach was mixed. The objective was to determine neuropedagogy as a methodological tool for improving the development of initial reading and writing skills in high school children at the Matilde Hidalgo de Procel Educational Unit in the city of Santo Domingo, Tsáchilas province. The procedural methods used were bibliographic, inductive, deductive, and descriptive. A correlational level of research was also determined, and the methodological design was quasi-experimental. Data collection techniques included surveys of high school teachers and pre- and post-tests of students. Data collection was conducted using the aforementioned instrument with high school students (control and experimental groups).

2 Materials and Methods

The research called neuropedagogy in the development of initial reading and writing skills adopted a mixed approach (qualitative and quantitative). Hernández et al. (2014), argue that the quantitative approach uses data collection to test hypotheses based on numerical measurement and statistical analysis, to establish behavioral patterns and test theories. On the other hand, the qualitative approach focuses on understanding phenomena, exploring them from the perspective of participants in their natural environment, and the context.

The objective is to determine neuropedagogy as a methodological tool for improving the development of initial reading and writing skills in high school children at the Matilde Hidalgo de Procel Educational Unit in the city of Santo Domingo, Tsáchilas province. The procedural methods used were bibliographic, inductive, deductive, and descriptive. At the same time, a correlational level of research was determined, and the methodological design was quasi-experimental.

Data collection techniques included a survey of high school teachers and a pre- and post-test of students. Data collection was conducted using the aforementioned instrument with high school students (control and experimental groups). Initially, a demonstration class was developed and evaluated for the control group, utilizing only writing exercises using traditional methods to develop fine motor skills. Secondly, a demonstration class was implemented and evaluated for the experimental group, incorporating simple elements of the visual arts, such as creating figures using modeling clay, to improve fine motor skills. It should be noted that the development of manual dexterity in children is related to the fine control of a tool using their fingers (McGrath & Yamada, 2023).

Fine motor skills in children must be fostered in early childhood, where the early stimulation of psychomotor activities helps children acquire precise movements that allow them to experience new skills; in this sense, fine motor skills are a skill acquired to master the movements of the arm, hand, fingers, and vision (Zambrano, 2022). Children find movement in their bodies as the main way to come into contact with the reality that surrounds them, and in this way, they acquire their first knowledge about the world in which they are growing and developing. The

progressive discovery of their own body as a source of sensations, the exploration of the possibilities of action and bodily functions, will constitute necessary experiences on which children's thinking will be built (Constante, 2017). The population consisted of high school teachers and students from the Matilde Hidalgo Educational Unit in Procel. The sample consisted of two groups of 10 high school students, each forming the control and experimental groups.

3 Results and Discussions

Neuropedagogy

Today, education faces a series of significant challenges, many of them generated by rapid technological advances, social changes, and the need to adapt to the demands of a globalized and diverse society. In this context, neuropedagogy emerges as a proposal that unites knowledge of neuroscience and pedagogy to improve the way we teach and learn, taking into account how the human brain functions and develops (Bravo et al., 2024).

Neuropedagogy is a science based on the study of the human brain, which must be understood as a social organ capable of being modified by teaching and learning processes, especially those involving play, and not simply as a computer. It is a discipline that is both biological and social; there can be no mind without a brain, nor a brain without a social and cultural context. The human brain is a processor of meanings, traversed by a vast cascade of emotional molecules that affect our mind and our corporeality (Tovar et al., 2019).

Neuropedagogy represents an emerging field that has gained relevance in the teaching-learning process in recent years. Therefore, it is necessary to mention the benefits of this discipline and how it can contribute to early childhood education. Furthermore, the human brain acts as an interpreter of meanings, influenced by a profusion of emotional molecules that impact both a child's cognition and their bodily experience (Zambrano & Mieles, 2023).

Neuropedagogy addresses recent advances in the integration of neuroscience and pedagogy to offer new strategies that improve teaching and learning processes and promote more inclusive education. It analyzes in depth crucial aspects such as the influence of emotions and motivation on learning, the importance of respecting sensitive periods of brain development, and how to implement teaching methodologies that take advantage of the brain's creative capacities (Moreno et al., 2022).

Neuropedagogy in the management of teaching-learning must have a direct impact on students, teachers, administrators, in general, on the educational community with the sole purpose of achieving the institution's objectives based on philosophy and contributes to generating a differentiating value in the educational offer it offers; therefore, the role is not only transformative, but integrative (Sesé & Gómez, 2021). In this regard. De la Hoz Blanco & Montes (2022) point out that early childhood education is the stage in which the training process takes place in children from birth to the age of six, seeks physical, affective, social and intellectual development, incorporates guidelines for coexistence, based on respect for differences, development of affective capacities and democratic values that facilitate social interaction (p. 48).

The implementation of strategies related to neuropedagogy for learning in any area of knowledge allows the opening of significant pedagogical knowledge in both teachers and students, since they facilitate the acquisition of academic content through various situations used to develop cognitive skills and abilities specific to each individual. (Díaz & Granda, 2022). For Herrera et al., (2023), a neuroactivating composition of pedagogy is glimpsed, where autonomy is achieved in the student, capable of learning from their intellectual means (p. 6475).

The integration of neuropedagogy into teaching allows for the enhancement of children's brain development in an inclusive and personalized way. Through understanding brain processes and their impact on learning, it becomes a facilitator of experiences; and, through this discipline, it is possible to understand and visualize child development processes through educational practices based on advances in neuroscience (Egaña, 2023).

Initial teacher training must align with the changing world in which we live and develop educational processes that value the close relationship between the scientific disciplines that study the brain and how it functions in activating learning processes. Students and teachers must learn to develop teaching skills, based on the principles of neuroscience, which take into account the cognitive abilities of each child to foster meaningful learning (García Vila et al., 2022).

In the field of education, neuroscience has been permeating teaching practice through the conjunction of three disciplines: neuroscience, pedagogy, and psychology, in a field of knowledge defined as neuroeducation. However,

there is an area of specialization that focuses more on the neurobiological analysis of brain-based learning, known as applied cognitive neuroscience (Díaz-Cabriales, 2025).

Neuropedagogy allows for an approach to teaching where the student experiences learning in a way that achieves their well-being, where there is pleasure in achieving the activity, optimism, and dedication to building a product and reaching a goal; this leads to success and becomes a remarkable experience in the brain, generating happiness, security, and self-confidence in the student, and thus elevating their self-esteem, thus regulating their learned behavior, influenced by this open learning environment that projects avoidance or acceptance of knowledge (Ramos & Concepción, 2022).

Neuroplasticity, defined as the brain's ability to reorganize and adapt to new experiences, has emerged as a promising tool in the field of neuropedagogy. In the educational context, where challenges in the quality of teaching persist, exploring innovative strategies based on brain function is essential to optimize teaching-learning processes (Barro et al., 2025). In this regard, Noro (2018) states that educating implies putting into motion various learning processes in educable dimensions, which allow us to delimit what we are, what we are becoming, and what we must become. We think about ourselves, we study ourselves, we express ourselves, and, with all these documentary sources, we educate: we educate ourselves throughout our lives and we educate others (p. 14).

Beginning literacy skills

Regarding the development of children's initial literacy skills, at the family level, we are accustomed to considering learning to read and write as a learning process that takes place exclusively at the educational institution level. It should be noted that many children who begin primary school at very elementary levels of conceptualization about the literacy system show the same progression during their first year of school that other children show before entering school, despite the fact that they are exposed to systematic attempts to make them directly understand the alphabetic writing system. According to Korzeniowski (2023), learning to read and write requires a set of initial skills and knowledge that children acquire through interactions with others in their upbringing contexts. Various factors shape the acquisition of these skills, including family socioeconomic status and the development of executive functions (p. 1).

In this sense, there is a need to foster a genuine habit of understanding texts, whether or not there are difficulties with encoding and/or decoding. However, this does not mean that we should stop trying; rather, we must face it now from our reality, because apart from the fact that there are many weaknesses for children to understand a certain text, there is also no justification for not doing so, neither for teachers nor for the socioeconomic environment in which the child develops. According Blacksmith et al. (2019), uone of the most determining factors that influence the development of reading and writing in children is, without a doubt, the participation of parents, the incorporation in the analysis of the socioeconomic environment of families allows us to have valuable information that helps us understand the reasons why children do not advance in their educational process, the work that meshes the work and experience of the teacher and the interest of the parent to give their child a good education is relevant.

One of the most important mental processes for understanding the textual level is the prioritization of information. The way information is prioritized when a hyperlink is activated on a computer screen is determined by the path one finds or selects. In analog text, establishing a hierarchy of information—that is, determining what is most and least important—is often a truly demanding task. Some texts make the process a little easier: for example, in a textbook, information marked in bold explicitly tells you what is important. But when reading a novel, a short story, or an essay, the task of prioritizing information falls to the reader. Meaning is constructed from the generation of mental representations as the reader progresses (Abusamra et al., 2009).

Preschool children already have notions of reading and writing because they have developed oral and written language skills that are related to each other and, in turn, to the acquisition of conventional reading and writing. Therefore, the teacher must determine the existing relationships between oral and written language in the preschool years and identify the initial language skills of the preschool child that enable the acquisition of conventional reading and writing (Guarneros Reyes & Vega Pérez, 2014). According to Yunga (2021), neurofunctions are cognitive, motor, perceptual, and language activities that occur through brain maturation and development from conception and throughout early childhood, where skills and abilities necessary for the acquisition of formal learning, such as reading and writing, are acquired (p. 37).

The process through which literacy develops is most evident during early childhood, as children, despite not having fully acquired these skills, demonstrate great interest in them. Furthermore, it is at this stage that children

develop skills and learn essential knowledge to generate their creations. Therefore, literacy is an essential skill in today's society, as it is involved in most of our daily activities (Chávez Delgado, 2022).

The design of the neuropedagogical environment must allow the student to participate, make decisions, take on new challenges, and use strategies, models, dynamics, mechanics, and elements typical of games in contexts other than these, to transmit a message or content or change behavior, through a playful experience that fosters motivation, recognizes their achievements, and at the same time achieves the objectives of the educational process in reading and writing (Molina, 2022).

It is important to emphasize that from a child's earliest years of school, strategies and plans are necessary to establish the foundations for the adaptation and preparation stages, which will awaken children's interest in curiosity and their desire to participate in the pursuit of new knowledge through reading and writing, supported by different learning styles through dynamic activities, short presentations, storytelling, dramatizations, and other activities (Esteves-Fajardo et al., 2022).

There are motor activities that promote the development of fine motor skills in children aged 4 to 5. Finger painting strengthens these skills by manipulating objects such as tempera paint, flour, modeling clay, paintbrushes, paper, water, and fabric. These activities allow children to actively connect with teachers and students in the classroom, creating a natural communication of feelings and expressions that promote creative thinking and meaningful learning (Castro, 2022).

To the above problem, the difficulties associated with children's lack of literacy development are not resolved with a new teaching method or new teaching materials. In children's daily lives, they see more letters outside of school than inside; they may try to interpret more text more frequently than at school; or they may try to produce more texts than inside. Consequently, this seemingly disorganized information constitutes written language in a social context of use and, therefore, is more understandable, while the methodology and information provided by teachers often become obsolete. In this regard, Noro (2018) points out that to educate, it is essential to define what is human and what human beings should be. The greatest richness in both definitions ensures the best education, because it will translate into a commitment to a comprehensive approach. Education is impoverished and betrayed if it categorically circumscribes and limits the vision of humankind and its possibilities for development (p. 1).

On the other hand, it is essential to differentiate, indicating that the problem lies not in text comprehension but in text production. There is a big difference between understanding a text and producing a text. In this regard, perception is everything related to the various processes and activities linked to text production, through which the brain gathers information related to its environment. The actions developed within it will depend on the child's mood and their level of connection with their environment (Alcivar-Cabrea & Andrade-Acosta, 2024).

Characterization

The purpose of the practice described in Table 1 was to demonstrate the practical utility of modeling clay figures in strengthening fine motor skills among high school students at the Matilde Hidalgo Educational Unit in Procel. The work was autonomous, with each child constructing their figures based on a theme proposed by the teacher. In this regard, the children in the experimental group used various colors of modeling clay, demonstrating that fine motor skills and cognitive abilities can be strengthened through neuropedagogy strategies in the visual arts.

Table 1
Characterization of practice n. 1

	**Practical description n.1** **Neuropedagogy of the visual arts** By manipulating modeling clay, the children were able to create their own figurines based on letter associations, utilizing neuropedagogy strategies to help children develop initial reading and writing skills. **Goals** ● Characterize letters using clay figures to strengthen fine motor skills and interpretation in children.

Table 2 shows the characterization of practice n.2

Table 2
Characterization of practice n. 2

	**Practical description n. 2** **Writing exercise** Through the implementation of reading exercises, children were unable to fully develop letter association exercises through the use of traditional strategies, resulting in poor development of initial reading and writing skills. **Goals** ● Develop basic writing exercises

The purpose of the practice (Table 2) was to demonstrate the practical utility of using traditional techniques to develop fine motor skills in high school children at the Matilde Hidalgo Educational Unit in Procel. The work was autonomous, with each child developing drawing exercises in their notebooks based on the theme proposed by the teacher. The children in the control group used various colored pencils. It was evident that some children did not yet have the necessary skill to draw the figures proposed by the teacher.

By analyzing the information collected through the implementation of a pre- and post-test based on the implementation of strategies related to neuropedagogy aimed at developing initial literacy skills, the purpose of the practice was to test the hypothesis: Ha = Strategies based on neuropedagogy develop initial literacy skills in high school students at the Matilde Hidalgo Educational Unit in Procel.

For this purpose, exercises were proposed to develop fine motor skills in children and, at the same time, obtain significant learning of reading and writing in children. For Llumipanta & García (2022), teachers in their daily work

should use different strategies to work on the psychomotor development of children, turning neuropedagogy techniques into an important link in the stimulation that the student needs to strengthen the muscles and joints of the hands and fingers before starting graphomotor activities (p. 187).

The proposed exercise, shown in Table 3, sought to demonstrate the existence of significant differences between the groups of children involved (Control and Experimental) concerning whether neuropedagogy strategies contribute to the development of initial reading and writing skills, making a comparison with obsolete strategies in the teaching-learning process of reading and writing. From a more general perspective, to verify whether the use of strategies based on neuropedagogy impacts meaningful learning of reading and writing in high school students at the Matilde Hidalgo de Procel Educational Unit in Santo Domingo de los Colorados.

The results obtained indicated that in the control group, at the pre-test level, a mean of 3.0 was obtained, while at the post-test level, a mean of 4.0 was obtained; that is, through the implementation of traditionalist strategies, these do not contribute to the development of initial reading and writing skills. The results obtained indicated that, in the experimental group, at the pre-test level, a mean of 3.50 was obtained, while at the post-test level, a mean of 5.20 was obtained, that is, through the implementation of neuropedagogy strategies, these do contribute to the development of initial reading and writing skills.

Table 3
Results obtained in the significant differences between the groups of children involved

Experimental Group Scores			Control Group Scores		
Students	Pre-test	Post-test	Students	Pre-test	Post-test
Exp1	3	5	Con1	3	4
Exp2	3	5	Con2	3	4
Exp3	4	6	Con3	4	5
Exp4	3	5	Child4	3	3
Exp5	4	6	Con5	3	5
Exp6	3	4	Con6	3	4
Exp7	4	6	Con7	4	5
Exp8	3	4	Con8	2	2
Exp9	4	5	Con9	3	4
Exp10	4	6	Con10	2	4
Media	3.50	5.20	Media	3.0	4.0

Source: Pre and post-test results of control and experimental groups

Based on the implementation of the pretest, the research provided the following information: The mean score for the control group was 3.00, while the mean score for the experimental group was 3.50. This shows that there was no significant difference between the two groups when measuring the initial literacy skills of high school children at the Matilde Hidalgo Educational Unit in Procel.

From the perspective presented here in Table 4, when analyzing the data collected at the post-test level based on initial reading and writing skills, a mean of 4.0 is evident for the control group and a mean of 5.20 for the experimental group. Based on this, a significant difference is recorded in the calculation of group statistics. For the control group, a standard deviation of 0.8944 was shown with a mean of 0.283 standard error. On the other hand, for the experimental group, a standard deviation of 0.9055 and a mean of 0.286 standard error were calculated.

Table 4
Analysis of differences

	Statistics post-test				
	Groups	N	Media	Deviation standard	Media del error standard
Post-test evaluations	Control	10	4.00	0.8944	0.283
	Experimental	10	5.20	0.9055	0.286

Regarding the problems related to children's lack of literacy development, these are not resolved with a new teaching method or new teaching materials. In children's daily lives, they see more letters outside of school than inside, they may try to interpret more text more frequently than at school, or they may try to produce more texts than inside. Consequently, this seemingly disordered information constitutes written language in a social context of use and, therefore, is more understandable, while the methodology and information provided by the teacher often become obsolete.

For your information, there is currently an impoverished image of the written language caused by the hypertextualization of language through social media. Therefore, it is necessary to reintroduce writing as a system of language representation into the consideration of literacy, given that over the years, an impoverished image of the learning child has been constructed. It is forgotten that behind every child lies a person eager to learn and construct meaning.

The reflection developed by Venanzetti & Báez (2024) is linked to the different levels of text comprehension based on the construction of children's knowledge and, at the same time, to good teaching practices. These refer to the way of teaching that includes the diversity of levels of conceptualizations that students develop around reading. In this sense, it is understood that the objective of teaching initial literacy in schools is to teach, taking into account the particularities of each process and proposing didactics based on activities and content based on the differentiated capacities or learning styles of children.

In this context, the research aimed to determine whether or not there is a significant difference between the implementation of strategies related to the neuropedagogy of the visual arts and traditionalist techniques in reading comprehension in high school students of the Matilde Hidalgo de Procel Educational Unit in Santo Domingo de los Colorados (10 students from the control group and 10 from the experimental group). Where, through the manipulation of modeling clay, children were able to make their figurines based on the theme proposed by the teacher, demonstrating that through the use of neuropedagogy strategies, children can develop initial reading and writing skills.

An analysis of the data obtained, based on the implementation of a pre- and post-test, revealed significant differences between these groups regarding the impact of neuropedagogy on the development of initial literacy skills. The differences established between the two groups of children indicate that, at the group statistical level, the control group had a mean of 4.0, showing a standard deviation of 0.8944 and a mean standard error of 0.283. Meanwhile, the experimental group had a mean of 5.20, yielding a standard deviation of 0.955 and a mean standard error of 0.286. Finally, significant differences were established between the control and experimental groups.

4 Conclusion

Regarding neuropedagogy in the development of a child's initial literacy skills, for illustrative purposes, it is essential to differentiate, indicating that the problem lies not in letter association but in their generation. Generating characters is essential for developing cognitive, motor, and social skills. It is also true that it cannot be developed without the collaboration and support of the student's environment. Furthermore, various factors influence the development of children's initial skills, such as the obsolescence of strategies developed by teachers and even the lack of parental collaboration.

In children's daily lives, they observe more letters outside of school than inside, they may try to associate letters more frequently than at school, or they may try to produce more texts than inside the educational institution. Consequently, this seemingly disorganized information constitutes written language in a social context of use and, therefore, is more comprehensible, while the methodology and information provided by the teacher often become obsolete.

The problem of the lack of development of initial literacy skills is related to the progressive development of children's daily reading habits on digital devices. About this issue, one of the most important aspects that impedes the development of these skills is the so-called information hierarchy. The term "information hierarchy" refers to the constant intentional use of so-called hyperlinks on a cell phone or computer screen; that is, opening and expanding the contents of a specific hypertext without following a sequence and without constructing an idea or meaning from a reading exercise.

Conflict of interest statement
The authors declared that they have no competing interests.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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