INTERVENTION IN GRAPHOMOTOR SKILLS: A CASE STUDY IN THE CONTEXT OF INCLUSIVE EDUCATION

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Abstract

Child neurodevelopment is a complex process that includes a series of psychomotor and behavioral changes from conception to adulthood. The integration of neuroscience knowledge into teaching practices has shown potential for improving the teaching-learning process, especially for children with learning difficulties. Graphomotor difficulties are closely related to fine motor skills. This is identified as one of the main areas of difficulty, manifesting itself in the grasping of small objects, in fitting tasks, and in visuomotor coordination, influencing part of their autonomy. This skill involves precise movements of the hands and fingers, which involve speed, accuracy, and reprogramming and actions. Based on inclusive education, this article presents a case study developed in a school in Portugal with a student attending the 1st grade of primary school who benefits from selective measures to support learning and inclusion under Decree-Law 54/2018 of July 6, which regulates Inclusive Education. This is a student with cognitive potential slightly below what is expected for his age group, and who, at the same time, has difficulties with graphomotor skills that have a negative impact on his learning. The case study took place in three phases: observation, characterization of the case, and intervention, throughout the third school term (March-May). The following objectives were outlined: to plan learning support activities to intervene in graphomotor skills, taking into account the student's profile; to develop the respective material resources; to implement the planned activities in the context of the inclusive classroom; to contribute to the improvement of graphomotor skills and, thus, of his learning. The intervention plan implemented was organized around different strategies: Strategies to expand graphomotor skills; Strategies aimed at cognitive development, with particular emphasis on fine motor skills, Strategies aimed at strengthening academic skills. The results indicate that the interventions promoted the development of graphomotor skills and thus contributed to greater success in school learning. Throughout the process, the student was receptive, participatory, and established a positive relationship that facilitated the work developed. The experience confirms the importance of personalizing educational responses, valuing school-family coordination, and providing individualized support for the child's overall development. However, it should be noted that this is a case study, very limited to a specific context, which impedes the generalization of results. In other words, these activities were implemented with a specific child in a specific context, so we cannot generalize the results obtained to all children with the same difficulties or to all contexts. Nevertheless, this study can serve as a reference for other interventions in other school contexts and for other types of research.

Keywords: Graphomotor difficulties, inclusive education, special educational needs.

1 INTRODUCTION

Child neurodevelopment is a complex process that includes a series of psychomotor and behavioral changes from conception to adulthood (Misirliyan & Huynh, 2020). It encompasses several areas, such as sensory, motor (gross and fine motor skills), cognitive, communicative, functional, social, academic, behavioral, and emotional. It is important to note that the stages of neurodevelopment vary naturally in their acquisition, and standard deviations from the mean may occur. Child neuropsychomotor development depends directly on the maturation of the central nervous system and the stimulation provided by the environment in which the child lives (Santana et al., 2024). This process involves the gradual acquisition of physical, cognitive, emotional, and social skills, influenced by biological, environmental, and nutrition-related factors. For example, high levels of stress during pregnancy can negatively affect the brain development of newborns, leading to emotional regulation difficulties, anxiety, depression, and learning problems in later life (Ünsel-Bolat et al., 2024).

The integration of neuroscience knowledge into teaching practices has shown potential for improving the teaching-learning process, especially for children with learning difficulties. Thus, pedagogical

strategies adapted to children's cognitive development are emerging, promoting more effective and personalized support for children's needs (Goldberg, 2022). To promote adequate motor and social development, it is essential that children develop self-esteem, confidence, and autonomy. Play plays a fundamental role in this process, as it stimulates both gross and fine motor skills, in addition to promoting cognitive maturity. Playful activities that involve various sensory perceptions, such as taste, smell, sight, touch, and hearing, allow children to better understand their abilities, improving body movements and working on aspects such as coordination, posture, balance, reflexes, and laterality (Gomes et al., 2024; Sutapa et al., 2021). Bidzan-Bluma and Lipowska (2018) highlighted that physical activity in childhood has been associated with improved neural connections, contributing to better learning and emotional regulation skills. Children who engage in regular exercise have greater brain plasticity, which reinforces the need for an environment that encourages movement and active exploration of the environment (Diamond & Ling, 2019). In addition to promoting cognitive and emotional benefits, physical activity also directly influences the development of motor skills, including fine motor skills. This can be stimulated through activities such as drawing, painting, cutting, educational games, music, reading, and exposure to children's stories, which require precision and coordination of movements.

In this context, the importance of preschool education emerges. Children who do not attend preschool tend to have greater difficulties in the first year of elementary school, especially in tasks that require fine motor skills and spatial orientation, such as holding a pencil correctly, joining letters, and positioning writing on paper (Guimarães, 2022). Writing, as a form of communication, requires children to meet certain social demands, such as legible handwriting and speed. Several factors influence the development of writing, including motor, general, and language development, in addition to factors of spatial-temporal structuring and environmental demands. Adequate psychomotor development, comprising both gross motor skills (for postural support and muscle support) and fine motor skills, is essential for good writing. Exercises carried out in the context of preschool education contribute significantly to the training of fine digital skills (Bonneton-Botté et al., 2023). For example, activities such as completing different graphic designs, painting with brushes, manipulating plasticine, or doing puzzles, and their continuous practice, are in fact essential for the development of writing. In addition, school requirements and teaching methods play a fundamental role in the development of children's writing.

Intelligence, affectivity, and socialization also influence writing development. Spatial orientation, for example, allows children to understand directions, directly impacting reading and writing. Difficulties in this area can lead to confusion between similar letters, such as “b” and “d” or ‘p’ and “q.” Temporal orientation is another essential factor, as it influences the rhythm and organization of writing. Children who have difficulties in this area may have problems structuring sentences and maintaining a logical progression in the text, impairing their written expression (Berninger et al., 2015). Therefore, pedagogical strategies that encourage writing practice in a playful way and adapted to each child's pace are essential for the balanced development of this skill (Parker & Thomsen, 2019; Parker et al., 2022).

In this context, the importance of early identification of signs of neurodevelopmental disorders becomes evident. These conditions, characterized by a persistent impact on cognitive and motor functions, often manifest themselves in the early stages of child development, often even before school entry (Hadders-Algra, 2021). To ensure effective intervention, the assessment of these disorders must be carried out through a multidisciplinary process, involving clinical observation, the application of formal assessment tools in various areas, such as psychology, speech therapy, and psychomotor therapy, in addition to complementary examinations. Among the areas frequently affected in these children, fine motor skills stand out. Impaired fine motor skills can have a direct impact on a child's autonomy in daily tasks, making it difficult for them to adapt to the school and social environment (Rafael et al., 2023). To minimize these impacts, fine motor skills stimulation programs, psychomotor activities, and specialized support in learning to write are effective strategies, allowing the child to develop their skills in a more structured and progressive way (Brown, 2010; Sutapa et al., 2021). Thus, creating a stimulating environment adapted to the individual needs of the child plays a central role in this process.

In this context, it should be noted that inclusive education has been gaining ground worldwide and, in Portugal, Decree-Law No. 54/2018 of July 6 is currently in force, which enshrines the principles, practices, and conditions for the implementation of inclusive education, as well as “establishes the principles and standards that guarantee inclusion” (Article 1).

Based on inclusive education, this article presents a case study developed in a school in Portugal, with a student who benefits from selective measures to support learning and inclusion under Decree-Law 54/2018 of July 6, which regulates Inclusive Education. Its objectives were: to plan learning support activities to intervene at the level of graphomotor skills, taking into account the student's profile; to

develop the respective material resources; to implement the planned activities in the context of the inclusive classroom; to contribute to the improvement of graphomotor skills and, thus, of his learning.

2 METHODOLOGY

This is a case study, part of a qualitative approach. It took place in different weekly sessions, totaling 35 hours. It is based on a characterization of the student at three important moments:

a) documentary analysis of the student's file, with a special focus on the analysis of the Technical-Pedagogical Report (RTP);

b) use of informal assessment resources adapted from the suggestions in the practice support manual (Pereira et al., 2018), namely “Person-Centered Planning Support Tool” and “Factors that significantly affect student progress and development”;

c) collection of information from the special education teacher, the educational support teacher, and the student's homeroom teacher for the 2024/2025 school year.

Information was also obtained through data collection from participant observation in the Learning Support Center (LSC) classroom and in classes guided and taught by the homeroom teacher.

Characterization of the case under study

The student is currently 7 years old and is in childhood. He lives in the city with his parents and sister. According to the RTP, he is part of a stable and well-structured family with a stable socioeconomic status. After applying the grid “Factors that significantly affect the student's progress and development”, the active and participatory role of the family and its involvement can be seen, which is considered a factor that positively affects the student's overall progress and development.

With regard to his school background, he attended five school years at a social daycare center and preschool run by an IPSS (Private Social Solidarity Institution) in the city. In the 2023/2024 school year, he was transferred to a group of schools in the city, in preschool education. According to the RTP, he would benefit from attending another school year to “develop and mature his cognitive, linguistic, and emotional skills.”

While attending this establishment, he underwent a psychological evaluation (2024) and was monitored by a speech therapist. He shows “cognitive difficulties, fine motor skills, memorization, comprehension, and application of knowledge.” He shows “a lot of motor agitation, his attention span and concentration are very short, and he shows some frustration when he can't do the tasks.”

In the current school year of 2024/2025, he attended the 1st grade at a school located in an urban area. He is monitored in developmental pediatrics consultations, with clinical information indicating that he has “cognitive potential slightly below what is expected for his age group, which may cause learning difficulties.” It also mentions the existence of many difficulties in terms of “graphomotor skills, which may limit his learning.”

The student receives speech therapy and occupational therapy.

He is a shy, friendly, cheerful child. He likes school, as well as the teachers and assistants with whom he empathizes. One factor identified as influencing his progress is the recognition of his progress and behavior by the various educational stakeholders, through various compliments and the application of different forms of reward.

In one of the activities to observe and collect data on his likes and characteristics, in which he used drawing to express himself, the student represented the human figure with little detail and using a limited range of colors when compared to his peers. Some parts of the body, such as the ears, were not represented, and there were an excessive number of fingers. In the same grid, he expressed his taste for painting and singing. This information makes it possible to verify his interest in artistic and musical activities, which may be an important resource to explore in the intervention.

From the observation carried out in the classroom, at the CAA, he demonstrated collaborative behavior during the intervention proposed by the special education teacher. However, greater difficulty in maintaining concentration throughout the intervention was observed. According to the teacher, throughout the intervention session, the period of concentration decreases considerably and there is greater motor agitation.

In the Social Studies class observed, he entered the room and sat down in a seat close to the teacher. According to the teacher, this is an area of interest to him, and this was clearly evident in his participation. He made several attempts to participate, identifying some images of animals. When completing a group exercise, even though he knew the answer, he turned to the classmate on his right to check the correct answer. He needed visual support to write the number three. During the class, he needed to get up once to empty his pencil sharpener, imitating a classmate. When called upon to do an exercise on the interactive whiteboard, with support from the teacher, he answered correctly, showing great satisfaction with his achievement.

During recess, he showed autonomy at snack time. When leaving the building, he walked with a friend, with whom he played ball. He showed a preference for playing with this friend.

In short, the data collected provides a better understanding of João's profile, identifying his main difficulties and interests, which are fundamental elements for the development of intervention strategies tailored to his needs.

This plan implements, in accordance with the Technical Pedagogical Report (RTP), the selective measures provided for in Decree-Law No. 54/2018, of July 6, Article 9, No. 2, namely subparagraph C), which establishes individualized psychopedagogical support at the Learning Support Center (CAA), with a workload of ninety minutes per week, tailored to the specific needs of the student. According to the RTP, "With regard to specialized support, the following areas will be worked on: Expressive and Comprehensive Language (developing oral language and approach to writing), Cognitive (attention, concentration, memorization), Affective Emotional (impulsivity), Fine Motor Skills, and autonomy in school tasks.

Following the recommendations provided by the student's RTP, as well as direct observation in the AAC context and in the classroom, the intervention plan developed focused on the application of strategies to expand and stimulate graphomotor skills, aimed at cognitive development, as well as the reinforcement of academic skills.

In order to ensure good motor and social development, it is essential that children develop self-esteem, confidence, and autonomy. Play plays a fundamental role in the acquisition of these skills, as it stimulates gross motor skills, fine motor skills, and cognitive maturity. Fine motor skills can be stimulated through activities such as drawing, painting, cutting, educational games, music, reading, and exposure to children's stories. Such practices promote the development of concentration, memory, logical and abstract reasoning (Macedo, 2009).

Thus, with the aim of effectively responding to their specific needs, while also addressing their areas of interest, the proposed activities were planned and organized according to the following strategies/activities. The specific objectives were: to expand and stimulate graphomotor skills; to promote cognitive development, with an emphasis on fine motor skills; and to reinforce academic skills through specific strategies. The activities were planned based on suggestions from the literature in the field, namely by Lima (2015), and also on the professional experience of the supervisor in the field. It should be noted that the intervention benefited significantly from the existence of recreational and educational resources at the school, namely diverse and adapted teaching materials.

3 DESCRIPTION OF THE IMPLEMENTATION OF THE INTERVENTION PROPOSALS

The following is a summary of the work carried out.

1) Strategies for improving graphomotor skills

1.1) Free and guided modeling with modeling paste

At first, a playful game with the letters of the alphabet was used, in which the student selected the letters and completed his own name, although with the need for visual support and assistance from an adult. The student showed considerable interest in manipulating plasticine, but faced challenges in creating small shapes with this material. He was asked to build his name using plasticine and did so, but with help. He was encouraged to produce different three-dimensional figures, for example, representing the human body. However, he needed to be reminded of the parts of the body. He enjoyed this material, and it was observed that manipulating it during the proposed activities calmed him.

1.2) Construction of a decorative element "Chick"

He was asked to write his name in cursive letters and again needed visual support to complete the task. He wrote his name unevenly and showed resistance to writing his surname.

He was then asked to color a template of a chick using brushes and watercolors. He showed motivation in choosing and using different colors. It was noted that he still did not hold the brush correctly. He showed enthusiasm and enjoyment for painting, but still exhibited some motor agitation (shaking his legs).

During the break, while the template was drying, he began coloring a drawing using the same painting technique, but this time with an ocean theme.

In the next step, the template was cut out. Although the lines were mostly straight, he managed to do it with a lot of help. He remained engaged with the work and did not give up. He managed to cut out the template. In the next step, he performed the folding technique with the help of an adult, using a ruler as a support.

To finish the work, he glued the parts of the template together with the glue stick, but did not apply enough pressure to spread and fix the pieces.

He showed interest in painting with brushes and used different colors. He still had difficulty holding the brush correctly, but made attempts to improve.

1.3) Creation of graphics related to the theme of spring; Guided cutting; Threading game; Graphics on geometric figures.

An activity was proposed involving the execution of different graphic designs, with various guidelines, the theme being spring. The child showed difficulty, especially in covering the curvilinear dots. Within this theme, the child performed a task that consisted of joining the dots to represent two animals (a butterfly and a bee). He did this with motivation and a desire to color. Although not very precise, he varied the colors and presented the work with pleasure.

With the aim of diversifying the instruments and promoting the development of fine motor skills, it was proposed that he cover the dots that indicated the path of the bee to the corresponding flower. These paths presented a variety of trajectories. After completing the drawing, the worksheet indicated that the path should be cut out. Initially, the student said it was very difficult, but with verbal encouragement, explaining that he should orient the sheet so that it followed the path and helped the bee, he took the initiative and cut out all the paths himself. João showed commitment to completing the task and wanted to put the result in his notebook, showing his satisfaction.

He also played a wooden "threading" game (see Figure 1) available at the school, with options for sequencing on a string or wire, with different orientations. The activity should be carried out in accordance with the instructions on the cards. He tried both supports, showing more difficulty but greater enjoyment in completing the activity with the wire support. There was a gradual decrease in concentration time and greater distraction. However, with encouragement, he completed the activity satisfactorily.

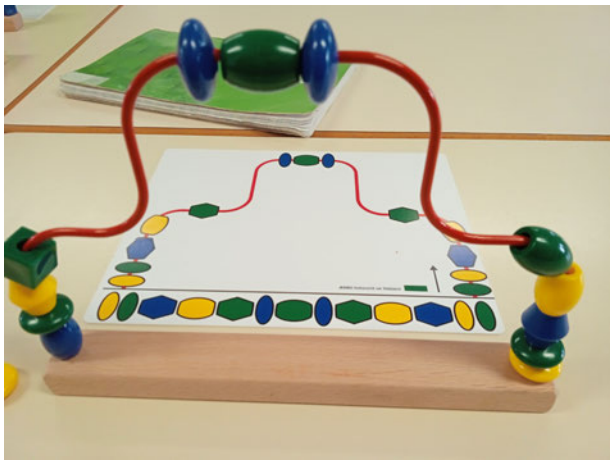

Figure 1. Threading game.

As part of the development of fine motor skills, he was given an activity related to geometric shapes, in which he had to identify, connect the dots, and color the images. He had difficulty covering the curved lines. To check his progress and improve his fine motor skills, one of the worksheets was colored with a brush and watercolors, and the other with colored pencils. He worked receptively and engaged, taking a short break, which was used to organize the table and talk a little about the work.

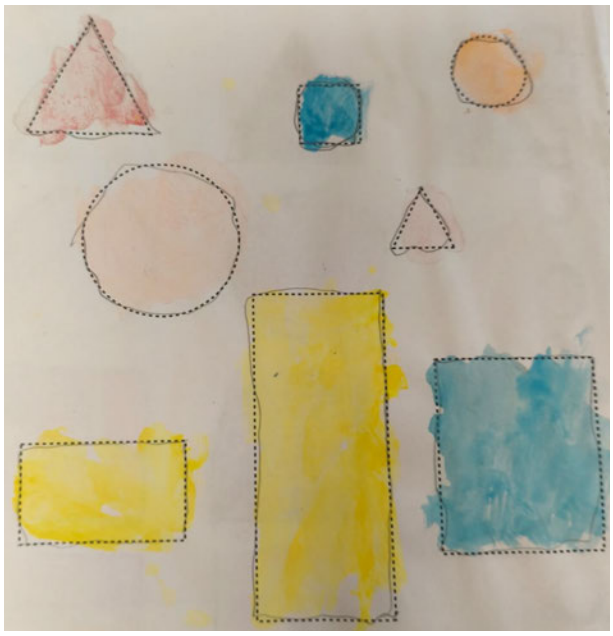

Figure 2. Geometric figures in dotted lines

2) Strategies aimed at cognitive development, with particular emphasis on fine motor skills:

2.1) Two-entry table (attributes)

The student was given a wooden game with a double-entry table, also provided by the school. The objective was to match the figures (in the vertical position) to the number (in the horizontal position), presented in the form of numbers or dots (see Figure 3). João showed interest in the game. On the board with numbers from 1 to 5, he was able to complete the task with little guidance. After completing the task, he made a mistake, which, with support, he was able to identify and correct. On the following boards, he needed more support to recognize the numbers and/or dots, as well as to count numbers greater than five. He also had difficulty handling the pieces and placing them correctly on the board.

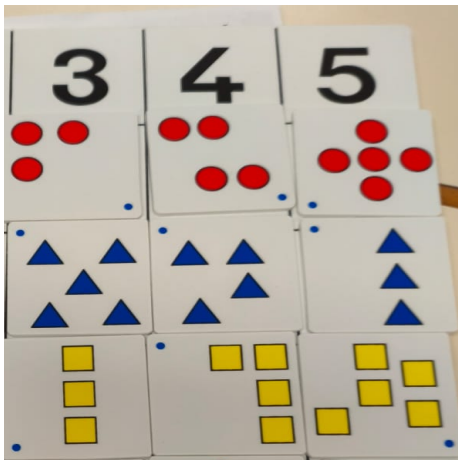

Figure 3. Figures in double-entry table

2.2) Visual perception/discrimination

He was asked to fill out a form with the aim of identifying and completing the missing parts of different faces. The student was able to recognize the missing parts, but had difficulty drawing them in the right place. Although he did not copy the model faithfully, he made attempts to do so. To reinforce these skills, he was asked to make a Mother's Day card, also with the aim of completing the human face. The activity motivated him. The student completed the face according to his mother's features. He still had difficulty cutting out the card, although there was an improvement in his ability to cut in a straight line compared to previous work. He concluded by writing: “For João's mother,” albeit with assistance.

2.3) Matching Categories Game

To consolidate skills in the area of cognitive stimulation, it was suggested that he play an educational robot board game. In this game, the goal was to learn/recognize different objects and associate them with those on the board (for example, if the coin card comes up, you have to trace the path to the piggy bank and program the robot). João was motivated and demonstrated a rich vocabulary. However, he had difficulty with spatial orientation, particularly between left and right, so he needed help.

3) Strategies aimed at strengthening academic skills

Following the implementation of the intervention plan, aimed at strengthening academic skills and improving fine motor skills, we started the day with a worksheet. The worksheet consisted of counting the syllables in a given word associated with spring and representing the number of syllables by drawing flowers. When he arrived in the classroom, the student was a little agitated and distracted compared to other sessions. He was distracted and often looked for ways to get up. With my encouragement and reinforcement, he counted the syllables and drew the flowers. Although he was not very enthusiastic, he took the initiative to write the number of syllables next to the image. It took him twenty-five minutes to complete the activity. In the end, he seemed satisfied with the result.

After completing the activity, he was offered a game with an animal theme, which consisted of putting pieces together to form animals in pictures and their respective words (like a puzzle, but with all the pieces in a rectangular shape). He showed enthusiasm for the theme and began to construct the different animal pictures. He then counted the pieces, each piece representing a syllable. He alternated between counting the pieces and dividing the syllables by clapping his hands. He showed curiosity in the game and noticed that the animal with the most pieces was the one with the most syllables. After completing all the animals, he was given the opportunity to play the game in a playful way. He built an animal with several parts and counted it to ten without help. He created freely for ten minutes. When told to tidy up the game, he did so happily and independently.

From direct observation, and compared to previous sessions, although motivated, he showed more fatigue and difficulty in maintaining attention. To help him regain his attention and focus, the strategy of manipulating modeling clay was used, and he was asked to represent the human figure. I used this strategy because during the first interventions, it was noticed that manipulating modeling clay calmed him down. He performed the task with pleasure.

Subsequently, he was offered a game that consisted of removing a card with a sum or subtraction operation on it and then representing that operation with his fingers. We did an operation together to explain it. First, we performed an operation and he corrected it; then he performed the operation and was corrected if necessary. With this dynamic, he showed more interest and involvement in the task.

To conclude the session, he played with an educational route programming robot and was asked to assemble the board, manipulating it with greater dexterity compared to previous sessions. In programming, he showed greater autonomy and attention span.

During the intervention, structured activities were alternated with moments of free exploration, helping to keep the student engaged and motivated. It is important to diversify resources and respect the child's pace, reinforcing motivation and concentration through playful and sensory tasks.

4 FINAL CONSIDERATIONS

This intervention was aimed at a child who benefits from selective measures to support learning and inclusion, in the context of the current Decree-Law 54/2018 of July 6, in force in Portugal. The student proved to be receptive and participatory, albeit for brief periods of time, establishing a positive relationship that facilitated the work carried out.

It was possible to observe that the school environment was organized and adapted to his needs. In class, he was integrated into the peer group, participating, within his possibilities, in the proposed and adapted activities, being encouraged by the teacher to get actively involved. However, he would benefit from the implementation of the measure to reduce the number of students in his class. The intervention focused mainly on strengthening his graphomotor, cognitive, and academic skills, using practical and playful activities aligned with his interests.

Among the strengths of this intervention were the creation of a positive relational environment, flexibility in adapting teaching strategies, and effective coordination with the entire teaching team and the family, factors that contributed to the improvement of the skills worked on. However, it is important to recognize some limitations, namely the short duration of the intervention period, which made it impossible to carry out a more in-depth and systematic evaluation of the medium- and long-term results. In any case, throughout the intervention, it was observed that the student was receptive and showed progress in improving his manual dexterity. The family informally expressed their gratitude for the commitment and success of the intervention, which they were able to see at home, and for the concern and care shown in the work carried out with their son. Positive feedback was also received regarding the intervention and the resulting progress from the special education teacher and the classroom teacher, who observed it on a daily basis at school. This information contributed to a positive evaluation of the intervention.

This intervention also reinforced the importance of the school as an inclusive space, capable of promoting the success and full participation of all children through tailored and integrated educational responses. It also highlights the relevance of a pedagogical intervention focused on the specific educational needs of students, contributing to the construction of more equitable and inclusive school paths. The experience confirms the importance of personalizing educational responses, valuing school-family coordination, and providing individualized support for the child's overall development.

However, it should be noted that this is a case study, very limited to a specific context, which prevents the generalization of results. In other words, these activities were implemented with a specific child in a specific context, so we cannot generalize the results obtained to all children with the same difficulties or to all contexts. Nevertheless, this study can serve as a reference for other interventions in other school contexts and for other types of research.

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