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From anthropological transfer to children's emotional health through motor stories

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Anthropology, in its various branches, explores human evolution and behavior in both biological and social contexts. The development of the prefrontal cortex, which occurs significantly during childhood and adolescence, is closely linked to the formation of executive functions and the establishment of the basis for future behavior. In this context, the social and educational environment, ranging from family to school, plays a crucial role in shaping the aspirations and vocations of young people. Reading, especially in the early stages of development, presents itself as a powerful tool that can foster interest in science and medicine. This article explores how the interaction between physical anthropology, child cognitive development, and literature can contribute to cultivating scientific vocations through children's narratives. The aim of this research is to encourage medical vocation in children, combining reading and physical anthropology by introducing historical characters, such as the "Roman legionaries" who inhabited Caesaraugusta (Zaragoza, Spain) in the 2nd century A.D., through a motor story aimed at schoolchildren. This approach is used as a scientific transfer tool to generate greater interest in the medical and anthropological field among children. As a result of this proposal, a book entitled "Maripi: the scientific gladiator" has been created and edited, which will be implemented in the early childhood education classroom after its publication. This book will not only narrate the experiences and the context of the Roman legionaries, but it is also designed to capture the attention of children and stimulate their curiosity about medicine. From this work it is concluded that reading at early ages can be a facilitating element for science, in this case physical anthropology, to contribute to enhance medical vocations in the youngest and also as a resource for transferring scientific knowledge to the youngest.

KEYWORDS

education, vocation, children's, physical anthropology, prefrontal cortex

1 Introduction

The human prefrontal cortex (PFC) is associative and is characterized by the degree of differentiation and regional specialization, differentiating specialized areas in the neocortex. It has three fundamental characteristics: folding, stratification, and the columnar arrangement of its cells. Folding allows for an increase in the cortical surface area to 2,200 cm², horizontal stratification allows the early configuration of up to six cellular layers, and the columnar arrangement allows for framing zones that regulate punctual processes of excitation and inhibition (Etchepareborda Simonini and López Lázaro, 2005). Embryologically, the generation of neural tissue during the 3rd week of gestation begins with neurulation (induction of the ectoderm for its transformation into neuroectoderm), where specific genes and regulatory elements are involved in the development of the cranial portion of the neural tube to generate the subdivisions of the neocortex (Cholfin and Rubenstein, 2008). In fact, the PFC can expand differentially and independently of the growth of other areas, and its size can be regulated in early stages by changing the expression of specific growth factors (Borrell and Reillo, 2012). After birth, the brain continues to grow through the development of dendritic processes and myelination of nerve pathways, while the cortical structure correlates with the development of more elaborate behaviors, and in particular, cerebral myelination of different regions occurs in different stages beginning with sensory and motor areas to continue with frontal and parietal association areas.

The frontal lobes are the brain structures whose evolution and development is more recent phylogenetically in the human brain, and it has been related to the need for more complex control and coordination of cognitive and behavioral processes, where behaviors based on motivations and interests and even the achievement of goals that are achieved through procedures and rules can be encompassed (Funahashi and Andreau, 2013). The PFC represents the center of control of mental activity, developing higher executive functions (EF) organized through multiple connections with other cortical areas (sensory areas of the temporal and occipital lobes and reciprocal connections with the amygdala and thalamus) and subcortical areas. These functions are defined as those processes whose objective is to facilitate adaptation to new situations and which require the operation of various interrelated cognitive procedures that participate in the synthesis of external stimuli, formulation of goals and strategies, and the preparation of action and verification of plans and actions whose result is directed toward a purposive and goal-directed behavior (Lozano Gutiérrez and Ostrosky Solís, 2011), whose development takes place during childhood and adolescence (Anderson, 2002), and although with a maximum development between 12 and 18 years of age, it has been observed that its development begins practically from 6 months of age (Zelazo, 2015).

In humans, the prefrontal cortex or frontal associative area, which represents 29%–30% of the brain volume, can be divided according to its different structure and functionality into several subdomains, such as the medial prefrontal cortex (mPFC), lateral prefrontal cortex (LPFC), and orbitofrontal cortex (oFC). Of these, the LPFC is involved in language

and executive processing, while the medial and orbitofrontal areas contribute to cognition and emotional control (Kolk and Rakic, 2022). In fact, it is considered one of the largest and latest-maturing portions in neurological development (Donahue et al., 2018), as the cerebral cortex increases in the number of neurons and surface area and also acquires new cell types and cytoarchitectural areas, covering 29%–30% of the brain surface (Carlén, 2017).

1.1 Connectivity of the prefrontal cortex

The important role that the prefrontal cortex presents over mental control makes it have a large and diverse connectivity. On the one hand, it presents indirect connectivity with the sensory centers through its associative areas where somatic, visual, auditory, and olfactory sensations converge, but it also has connections with the limbic system (the limbic sensory experience can be a source of motivation for later decision-making), the caudate nucleus, the cerebellum, and the superior colliculi and pretectum. Additionally, the importance of the corpus callosum in balancing both cerebral hemispheres should be highlighted. The corpus callosum, and in particular its rostral portion and the genu or knee, is the main bundle of white matter fibers that connects the prefrontal areas (central and lateral) and acts as a distributor of perceptual, motor, cognitive, learned, and voluntary information between the two cerebral hemispheres (Mooshagian, 2008; Wahl et al., 2007).

1.2 Maturation of the prefrontal cortex

The development of executive functions is linked to the maturational process of the brain and particularly of the prefrontal cortex, so the changes produced in this region make the evolution of these functions possible (Rubia et al., 2006). Prefrontal gray matter increases in volume until the age of 12 to decrease progressively from that age, while white matter volume does not stop increasing during childhood and adolescence, associated with cephalocaudal myelination of the cortical pathways of this brain region (Fuster, 2002) which extends beyond the second decade of life.

1.3 Educational intervention as a generator of PFC growth

Throughout the process of PFC development, along with the aforementioned connectivity, emotions appear as a determining factor. They are present from the child's birth and are used as a means of adaptation and a way of communicating with our environment, considering emotional development as one of the fundamental pillars associated with the development of the PFC from early ages. Emotions are directly related to motivation and the learning process, as various emotions can direct behavior toward different purposes, from enthusiasm, pain, fear, anger, love, or joy. Similarly, different emotions can be associated with particular physiological and visceral reactions. Both are basic relationships in the learning process of children (Estrada,

2018). Other authors (Goleman and Senge, 2016) affirm that when students tune into what matters and attracts them, they simultaneously establish a connection with their interests, which provokes intrinsic motivation that reveals what they truly want to learn and why. Emotional intelligence is an aspect that each individual must develop from the beginning of their personal and social development. Its importance lies in generating ideas and interpretations of their feelings, tuning into emotions, being able to understand them, and taking the necessary measures to face them positively and/or negatively in everyday life.

Socio-emotional health in children, including aspects such as self-regulation and empathy, is essential to create a safe and supportive learning environment. Integrating emotional intelligence programmes into the school curriculum not only improves students' socio-emotional health but also facilitates the identification and development of vocations that will be essential in the child's future personal fulfilment (Bisquerra Alzina and Hernández Paniello, 2017; María and Salguero, 2011). In this regard, UNESCO highlights the importance of early vocational education and guidance, indicating that it should begin from the early years of schooling, as it provides children and adolescents with the necessary knowledge about the professions, they can pursue in the future (Álvarez Benítez et al., 2020). Vocational guidance from educational centers will allow students to know their skills and abilities and reduce the risk of making mistakes in the future (Contreras-Pérez et al., 2018).

One way to intervene and generate scientific vocations from very early ages is to work from educational centers with tools aimed at disseminating knowledge to schoolchildren. Scientific production in terms of scientific publications has grown exponentially in recent years (Bermeo Giraldo et al., 2021), but this has not been the case with scientific dissemination aimed at schoolchildren. Spanish educational laws, based on the objectives set by institutions such as UNESCO or the European Union, have emphasized the importance of promoting the knowledge society as a backbone of education in the early stages (Agencia Estatal Boletín Oficial del Estado, 2020). In fact, numerous national educational policy documents highlight the great value of teaching science to children from the preschool stage (Åkerblom and Thorshag, 2021; Delserieys et al., 2018; Napal Fraile and Vázquez Bienzobas, 2023). Educational experiences based on promoting the transmission of science and knowledge at different educational stages show coincident results in student involvement in the process and the consequent assimilation of learning about the content addressed (Martín-Pena et al., 2020; Scazzocchio et al., 2021). Therefore, it seems necessary to incorporate this way of working in the early stages, given the direct relationship between experiences lived in them and adult life, with special interest in promoting the mental health of schoolchildren (Barwick et al., 2012; Saunders et al., 2022) and also in identifying scientific vocations (Álvarez Benítez et al., 2020).

Currently, the dissemination process involves a concern about the real impact or reach of the generated knowledge to the general population (Bermeo-Giraldo et al., 2021; Flores-Aguilar et al., 2023; Nájera Larumbe, 2023). Thus, in a society characterized by the constant development of information and communication tools (Rodríguez-López, 2021; Trujillo-Torres et al., 2023), it is convenient to exploit other ways of diffusion and dissemination,

such as the case of stories aimed at young schoolchildren and their use in the classroom.

Current children's literature has gone from being those artistic works intended for a child audience as a means of entertainment and amusement to being considered as the set of manifestations and activities based on the word with playful and educational purposes that interest the child audience and are a present reality in society, posed as a value in itself. In fact, through literature, feelings, values, behaviors that children will like or not can be observed, and they will see the causes that lead the characters to act or feel in a certain way and the consequences of their actions and/or emotions (Rodríguez-López, 2021; Trujillo-Torres et al., 2023). Stories are one of the most powerful tools for the development of emotional education where the child can experience experiences and enter a fantasy world that can represent everyday life realities that enhance their imagination and creativity (Hopkins and Weisberg, 2021). Moreover, they improve expression and interest in other types of languages and communicative forms, improve and enrich speech, reinforce values, practice collaborative work that leads to learning without excluding the student from their immediate environment. Similarly, they allow interaction and involvement with their family, generate role-playing games, and discover capacities usually hidden by various factors. Sandoval (Sandoval, 2019) shows that the children's story is not only important because it serves as a stimulus for the future reader but also because it contributes to the development of language, literary creation, imagination of possible worlds, among other aspects. On the other hand, by recreating the lives of the characters and identifying with them, it allows the student to live a series of experiences and situations that will help them gain more self-confidence, integrate, and be part of the world around them (López-Montero et al., 2022).

After this analysis of relationships between the structures and intrinsic elements in the development process of children and their school education, and based on the need for positive emotional experiences in children during the development of the PFC, a research project developed from scientific anthropology is presented, whose objective is the creation of a motor story for children's education students, as an element of transfer and dissemination of scientific knowledge and as an engine of scientific vocations from equality. To this end, and following the initial results of the anthropological research, the following will be generated didactic materials for preschool students as a result of interdisciplinary work between doctors and teachers, with the aim of promoting scientific vocations through motivation and enjoyment in classrooms through motor stories and their transfer to the subject of Physical Education (PE).

2 Materials and methods

An anthropological study was conducted on skeletal remains from 12 tombs found in excavations carried out in the center of the city of Zaragoza (Spain) belonging to the Roman period (Caesaraugusta, 3rd century AD). Of all these subjects, the cranial and post-cranial skeleton found in good condition in tomb IV of a male subject about 28 years old and about 170 cm tall with morpho-anthropological characteristics and funerary equipment compatible with a Roman legionary was individualized. This subject presented

bone stress markers at the anterior face of the patella due to the imprint of the patellar tendon and at the posterior face of the calcaneus due to the Achilles tendon, as well as stress fractures in metatarsals. All this indicated how his life had been with long walks carrying a lot of weight and great physical effort. The significant degree of dental wear in all preserved pieces, with the onset of periodontal disease, was the result of the extreme stress they were subjected to, as well as the presence of tartar.

The exhaustive study of these skeletal remains provided relevant information about the person they belonged to: dating of the period in which they lived (carbon 14), cause of death, and morphological and morphometric information, allowing us to know how the legionaries who lived in Caesaraugusta in the 2nd century AD (Zaragoza, Spain) were and how they lived, and even reproduce their physiognomy with digital tools.

The scientific dissemination methodology used to make this research known followed a different development from the usual in this area of knowledge. Through an interdisciplinary team of six people, the idea, plot, and writing and illustration of a story that, with language appropriate for preschool students, valued science and scientific vocations through Roman history, were developed. Subsequent to the writing of the story, proposals were assigned for motor actions in which the schoolchildren, representing the characters in the story, could develop their perceptual-motor skills, motor coordination qualities and basic and generic skills.

The working methodology for the creation of the motor story was developed in three phases (Figure 1), with all the members of the team interacting, coordinated by one of the teachers from the Faculty of Education of the University of Zaragoza.

2.1 In the drafting phase different steps were addressed

- The character was defined (Maripi, a shy but curious 5 years-old girl).
- The social context and settings were defined (a middle-class family in a working class neighborhood in Zaragoza where the protagonist hears on television a news item about the discoveries made by a doctor about the Roman gladiators of the past).
- We defined what the character wants and why she wants it (Maripi is not sure if she would like to be a great Roman gladiator and defend Zaragoza, or a scientist who would discover how to return to the past).
- She defined what to do to make up her mind and the consequences of her actions (she dreamt that she was each of the two characters in her dream and together they faced an adventure in Caesaraugusta).
- The final outcome was defined in an open-ended format, with the intention of leaving the readers thinking.
- The values to be developed with the text were defined (courage, strength and sociability through the figure of Gladiator. Creativity, intelligence and perseverance through the figure of the Researcher. Equality and scientific vocation through the figure of Maripi).

2.2 In the illustration phase

- The illustrator was selected for previous works with similar retro esthetics. The chromatic needs to differentiate the times of the story, the three defined scenarios (house, Maripi's room and Caesaraugusta adventure space) and the characteristics of the characters to bring them to life in the illustration were explained.
- The structure of the book was structured in 12 illustrated texts.

2.3 In the motor tasks phase for the development of laterality the following are selected

- Related to the body schema to increase the quality and perceptual discrimination with respect to one's own body.
- For the development of basic motor skills, with a more accurate grasp and much more coordinated locomotion, facilitating exploration of the environment and the interactions established with the body.
- Related to body axes and spatial organization with reference to the position of the body (what is in front and what is behind, right and left, above and below).
- From the most elementary spatial planes (up-down, front-back) to the most complex (right-left).
- Tonic and respiratory control, postural control and balance.

With all this work done, 12 simple texts were written in capital letters and distributed over the eight pages of the book. Each text was assigned the motor tasks to be carried out related to the text of each situation, and finally the illustrations corresponding to each of the texts were designed.

3 Results

An interdisciplinary team of doctors/teachers from the Faculty of Medicine and teachers from the Faculty of Education and a historian, all belonging to the University of Zaragoza (Spain), using as the main material the results of the anthropological research previously carried out, created a story that narrates the life of a Roman legionary told by a forensic anthropologist on television and how a girl, after hearing the news, traveled to the past to become the first Roman gladiator in history, who, with the help of the first scientist in history, saved Caesaraugusta from being attacked by the bossy pupils of Maripi's school.

For the creation of a motor story, an interdisciplinary approach was used, combining elements of literature, pedagogy, and medicine, while integrating research data. The narrative and activity parts were structured to incorporate specific movements, such as jumping, running, or swinging, which children must perform while listening to the story, in order to promote motor and cognitive development in the classroom. The story is structured in such a way that the movements are interspersed with the narrative,

PROCESS OF CREATION OF THE MOTOR STORY

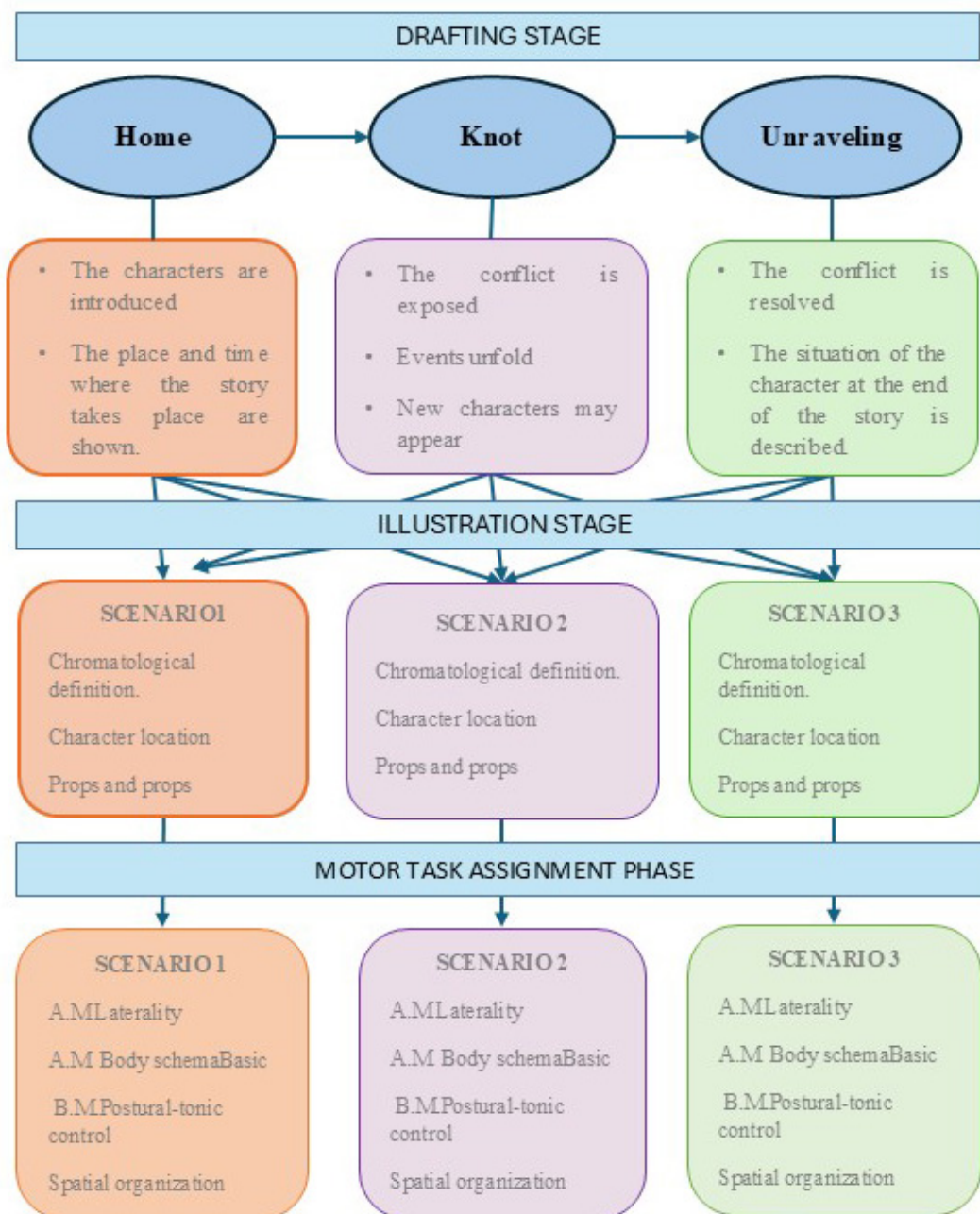


FIGURE 1
Representation of the history development.

creating an interactive experience for the pupil, who, by playing and collectively experiencing the story represented and staged through movement, the pupils and the teacher themselves acquire a high level of protagonism.

An attractive and age-appropriate plot was defined, integrating characters and settings. Simple yet enriching language was used, facilitating comprehension and the learning of new concepts. Additionally, values and emotions were incorporated to allow children to identify with the characters and reflect on their own experiences. Visual elements, such as colorful and detailed

illustrations, were created to help follow the storyline and are crucial for capturing and maintaining the interest of young readers. The illustrations used were colored in two different tones, allowing differentiation between when the characters were living in the present and when the story unfolded in the protagonist's dreams. The story was designed not only to entertain but also to educate, addressing relevant topics such as science, history, interpersonal relationships, and scientific vocations.

Currently, it is in the process of being published by the University of Zaragoza Press (PUZ) and has been presented

to teachers and students of this University belonging to the Early Childhood Education Degree studies, future teachers of preschool centers.

4 Discussion

It is not the first time that medical science has resorted to literature as an element of scientific dissemination for children (Åkerblom and Thorshag, 2021; Napal Fraile and Vázquez Biezobas, 2023). Authors from different areas have published works that demonstrate this statement (García-Carmona, 2021, 2023; Martín-Pena et al., 2020; Scazzocchio et al., 2021).

The literary technique of the story that narrates the life history of its characters is usually associated with the scientific field of psychology, mainly dealing with personality development in its relationship with the social or cultural environment rather than the social facts themselves. However, the contributions made from sociology or social anthropology leave in the background the work carried out by their scholars and focus on the value of their results to transfer them to society, which often does not provide academic value to scientists, tending to publish their research in scientific journals. Hence the proliferation of these publications (López-Montero et al., 2022).

The choice of the story as an educational resource and transfer of this anthropological research is motivated by several aspects: it is a flexible educational resource that addresses any area of study, allows working in different areas of knowledge, introduces the cognitive aspect of the student and socio-affective aspects that favor the teaching-learning process. The story is a motivating agent that arouses great interest in children, allowing them to turn the fantastic into real, identify characters, unleash their fantasy, imagination, and creativity, and soften tensions and resolve conflicts (Hopkins and Weisberg, 2021). It generates a positive attitude in students and has great value that can be used by science to awaken interest in its area of study, acting as a facilitator of thinking from a pedagogical perspective, as it enables learning, dynamizes thinking skills, and weaves a solid structure with social skills in building autonomous human beings capable of making decisions and solving inferences that may arise at some point in life (Dasu et al., 2023; Meves and Rodríguez Herranz, 1978). This makes them more accessible and can be more easily understood by students because they immediately connect with the affective zone (Meves and Rodríguez Herranz, 1978).

This dissemination tool created in this research can be used in Early Childhood Education classrooms from any of the three areas established by the preschool curriculum: harmonious growth, discovery and exploration of the environment, and communication and representation of reality. The most significant use of stories in early childhood education is through the motor story from the PE area. This resource can be related to innovative and active methodologies such as gamification, achieving to awaken the motivation of students by combining play with the narrative itself (Bermeo-Giraldo et al., 2021; Sevilla-Sánchez et al., 2023).

This didactic tool not only allows developing the motor skill of the student through the representation of an existing or fictitious story or tale freely by the student, fosters their

creativity, and also enhances their ability to express themselves in response to the stimuli received from the teacher. This variant of the story, which is generally used as a reading form orally, becomes a represented story where play situations occur during its course through the teacher's narrative, creating a motivating situation for the student that immerses them in the story and encourages them to participate in their learning and be aware of the process carried out for it, generating enjoyment of the activity and significant learning. Therefore, the motor story is considered an "ideal" work tool in the PE subject (Sanz Torres, 2023).

The didactic proposal presented in this research, regardless of the value of the data, shows how stories and tales have been used to show the contributions of women to the advancement of science and technology, combating the androcentric culture that still prevails in school textbooks and providing female role models in the scientific-technological field, fostering scientific vocations, aspects of great importance in the choice of studies and future way of life (Calvo-Iglesias, 2019). All programmes and actions carried out by governments, institutions, associations, organizations, etc., aimed at giving visibility to the role of women and girls in science and supporting and fostering STEAM vocations are not enough. They must be supported by previous scientific training of citizens that can only be achieved by starting it in the early educational stages. For this, as Cossío would say, we must have good teachers well trained in science, which the teachers themselves consider necessary and demand. A well-trained teacher serves as a guide to children so that through carefully designed experimentation, they can, as their teachers did before, take on the role of the discoverer. Thus, they come to feel the same excitement as the corresponding scientists and get hooked on science, which they identify as what it truly is: a true game of discovery (Gómez et al., 2021).

5 Conclusion

Interdisciplinarity opens the door to science, and in this case to physical anthropology, to reach schoolchildren and intervene in their emotions from a very early age in parallel to their physical and emotional development, through the creation of a motor story as an element of knowledge transfer and dissemination.

All this using tools that leave aside the new technologies and achieve, through the narrative in the form of MOTOR stories and their characters, scenarios and novel and motivating stories, to make science accessible and attractive to the school population.

In conclusion, it has been possible to write a children's story with a balance between simplicity and depth where imagination, values and language have come together to create a work that not only entertains but also educates and leaves a mark on the emotional and intellectual development of children, making young readers dream, learn and grow emotionally through the pages. This motor story will allow once published its implementation in kindergarten classrooms and it will be possible to study and measure its impact among schoolchildren. This is the challenge that we hope to have met with the creation of this driving story entitled "Maripi: the scientific gladiator."

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

MAC: Writing – original draft, Writing – review and editing. AG-B: Writing – original draft, Writing – review and editing. ERO: Writing – original draft, Writing – review and editing. CP-L: Writing – original draft, Writing – review and editing. JW-O: Writing – original draft, Writing – review and editing. AC-G: Writing – original draft, Writing – review and editing.

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Conflict of interest

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