

LEGO Braille Bricks: an international proposal for playful and inclusive literacy for children



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Abstract: The objective is to investigate how playful learning occurs in educators' training for the use of LEGO Braille Bricks (LBB). This is documentary research in which one of the activities conducted during the training in 2023 was analyzed. The results indicate that using LBB in children's literacy provides a more playful and effective learning experience and contributes to school inclusion.

Keywords: Literacy; Inclusion; Braille; Playful; Internationalization.

LEGO Braille Bricks: uma proposta internacional de alfabetização lúdica e inclusiva de crianças

Resumo: O objetivo é investigar como a aprendizagem lúdica ocorre na formação de educadores para o uso do LEGO Braille Bricks (LBB). Trata-se de uma pesquisa documental na qual foi analisada uma das atividades feitas na formação realizada no ano de 2023. Os resultados apontam que o uso do LBB na alfabetização de crianças com e sem deficiência visual proporciona um aprendizado mais lúdico e efetivo, além de contribuir para a inclusão escolar.

Palavras-chave: Alfabetização; Inclusão; Braille; Lúdico; Internacionalização.

LEGO Braille Bricks: una propuesta internacional de alfabetización lúdica e inclusiva para niños

Resumen: El objetivo es investigar cómo se produce el aprendizaje lúdico en la formación de educadores en el uso de LEGO Braille Bricks (LBB). Se trata de un estudio documental en el que se analiza una de las actividades realizadas en un curso de formación realizado en 2023. Los resultados muestran que el uso de LBB en la alfabetización de niños con y sin deficiencia visual proporciona un aprendizaje más lúdico y eficaz, además de contribuir a la inclusión escolar.

Palabras clave: Alfabetización; Inclusión; Braille; Lúdico; Internacionalización.

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1 INTRODUCTION

Literacy is a fundamental process for promoting inclusion and equal educational opportunity. When combined with a playful approach in an inclusive educational environment where all children have the opportunity to learn together, this process can be particularly beneficial. Children with and without visual impairments (VI) can develop literacy skills in a playful way, promoting cognitive and social development and fostering an environment of equality, respect, and cooperation.

Play in education is a fundamental aspect that promotes the holistic development of children and the learning process. Observing play, whether free (without guidance or support) or guided (with deliberate support from adults, while maintaining playful elements), captures the true essence of play and explains its relationship to learning (Zosh *et al.*, 2018). It is a methodological strategy that stimulates the acquisition of emotional, relational, and cognitive skills and allows children to learn through experience and creativity (Sgambelluri, 2015).

To enable children with and without visual impairments to learn to read and write together in a playful and inclusive environment, in 2016 specialists from the Dorina Nowill Foundation for the Blind (FDNC), an international reference and pioneer in the rehabilitation of people with visual impairments in Brazil, sought a playful resource to facilitate learning the Braille system. The solution was proposed by the advertising agency LewLara/TBWA, which suggested creating a toy inspired by traditional LEGO bricks. The innovation was to adapt the cylindrical interlocking parts of the pieces to represent the letters, numbers, and accents of the Braille alphabet. This allowed children to combine the pieces to form words and sentences in the Braille system without losing the original functionality of fitting the pieces together. In this way, children were able to create words and build corresponding three-dimensional objects, combining writing, shape, and play. After the first tests with children with VI at FDNC, the need was identified to insert printed letters on each piece corresponding to the Braille symbols, so that blind and sighted people could know what the letter was in both systems, as shown in Figure 1. In 2017, FDNC sought a partnership with the LEGO Foundation, a global reference in children's toys, for the large-scale production of the resource, from then on called LEGO Braille Bricks (LBB).

Figure 1 - Parts of the LBB pedagogical resource for inclusive literacy



Source: Photo produced by the first author (2024).

In Portuguese, the LBB kit currently consists of 344 colored pieces, a divider, and three base plates, allowing children with and without VI to play and learn together. The kits are produced by the LEGO Foundation and distributed in 18 languages in 30 countries. Until 2024, Brazil will be the only country in Latin America to receive them. Since 2019, the FDNC has distributed 9,647 kits to Brazilian public schools that have children with VI and to institutions that support these people. The intention was to transform the Braille system into an accessible tool for children with VI enrolled in public schools, thus promoting the literacy process in a playful and inclusive context.

LBB kits are distributed through a partnership agreement between the FDNC and municipal education departments or institutions that provide support to people with VI. Only schools that have children with VI between the ages of 4 and 10 receive the kits, four of which are intended for use in the classroom and one for the multifunctional resource rooms. Delivery of the kits to the schools is coordinated by the municipal departments of education.

An international educator training program will be developed in conjunction with the distribution of the kits. According to the LEGO Foundation ¹, an Official Partner will be established in each country where the kits are distributed, to be responsible for distribution and training support. In Brazil, educator training in the use of the LBB will be coordinated by professionals from the FDNC in collaboration with researchers from the State University of São Paulo (UNESP) and the University of Western São Paulo (UNOESTE).

This training is developed in an online format, with a total workload of 100 hours, and involves regular classroom teachers, Special Educational Assistants (SEAs) working in multi-functional

¹ See more at: <https://legobrainlebricks.com/getbricks>

resource rooms, school administrators, educational secretaries, and professionals from institutions supporting people with VI. During the training, educators will develop and implement a strategic intervention plan (PIE) for the use of LBB in inclusive school contexts.

By the first half of 2024, 6,369 educators from 89 Brazilian municipalities will have participated in the training. At the end of the program, the trained educators are expected to become multipliers of the pedagogical principles and methodologies applied, promoting in-depth knowledge about the use of LBB as an educational resource.

This partnership is considered a form of internationalization based on pedagogical aspects, playing a fundamental role in expanding educational opportunities and promoting quality education worldwide (Barros, 2023). By integrating pedagogical practices and resources from different cultures and educational systems, as is the case with LBB, it is possible to demonstrate how the literacy process can be developed in an inclusive context. This exchange of experiences and methodologies enriches and expands the repertoire of educators and ensures that effective practices are shared and incorporated according to local needs.

In the context of inclusive education, internationalization plays an important role in introducing innovations and approaches that enhance learning for all children, regardless of their abilities or disabilities. Thus, pedagogical internationalization is essential to promote educational equity. In this way, this resource aims to make a significant contribution to literacy by making the Braille system accessible and manipulable to children with VI around the world. The use of LEGO bricks with Braille pins facilitates the understanding of the writing system through play.

The training program is consistent with the assumptions of Zosh *et al.* (2018), who define play as an activity in which the process is more relevant than the final goal, allowing for the creative combination of objects and roles. Furthermore, the authors emphasize the importance of positive affect, noting that children often show smiles, laughter, and satisfaction during play. This manifestation of joy suggests that play when integrated in a playful way into the educational process, can contribute significantly to children's cognitive and social development by promoting interactivity, social interaction, meaning-making, and active engagement..

According to Hirsh-Pasek *et al.* (2015), the fundamental pillars of learning that are central to the learning sciences have remained constant over the years. The authors state that people learn more effectively when they are actively involved and engaged with learning materials. They also point out

that it is essential that learning experiences be meaningful and that there be quality social interactions around the materials.

Training educators in the use of PIEs helps them understand how to apply these playful methods to the teaching and learning process. When developing PIEs, educators consider pedagogical strategies that allow children with and without VI to learn together using LBB.

To this end, the purpose of this research is to investigate the presence of characteristics of playful learning - joyful, socially interactive, meaningful, iterative, and with active engagement - in the PIEs developed by educators during training, and to explore how these characteristics relate to the literacy process in an inclusive context.

2 PLAYFUL LEARNING AND LITERACY THROUGH THE BRAILLE SYSTEM

Literacy is a stage that all children, whether or not they have a VI and are of school age, typically go through to develop mastery of the written system and language. This process involves recognizing and understanding letters and words, as well as developing skills in interpreting, producing, and using text. In addition, literacy is essential for good expression and communication, access to information, and the development of knowledge.

According to Regulation No. 3.128 (Coffito, 2008), VI can be characterized by the total (blindness) or partial (low vision) loss of the visual capacity of one or both eyes. Blindness is defined by the World Health Organization as a condition in which the visual acuity is less than 0.05 or the visual field is less than 10°. Low or subnormal vision is defined as a visual acuity corrected in the better eye of less than 0.3 and greater than or equal to 0.05, or a visual field of less than 20 degrees in the better eye with the best optical correction. During the literacy process, children with VI, especially blind children, learn the representative writing system, that is, the Braille system.

This is a universally used system for writing and reading by people with visual impairments, especially the blind. Adopted worldwide, it has become an important resource for communication, expression, professionalization, independence, and inclusion of this population, and it is the only way for blind people to become literate (Brasil, 2018a). Teaching the Braille system must occur simultaneously with literacy, and it is in the regular classroom that children learn the literacy skills that are critical to becoming highly proficient Braille readers (Croake; Gentle; Duncan, 2024).

The Braille system consists of 63 characters formed from the matrix set (123456 dots). This set of six dots is called the fundamental sign. The space occupied by it, or by any other sign, is called a Braille cell or Braille cell, and when it is empty, it is also considered a sign by some experts, so the system consists of 64 signs (Brasil, 2018b).

LBB is a pedagogical tool that aims to make learning the Braille system more accessible and fun for children with VI while facilitating a literacy process in an inclusive context. The use of this resource in a literacy context aims to contribute to the joining of letters, the formation of syllables, supports the formation of words, the creation of short sentences, and can be used in the literacy process of blind children as well as children who do not have this disability.

It is therefore evident that the LBB offers a pedagogical solution that helps teachers, in the context of inclusive education, to use a resource for the development and literacy of all children, to contribute to the construction of learning environments that favor learning, improving the literacy process in an inclusive context, considering the characteristics of playful learning used by the Lego Foundation (FL) in its training.

These scientifically based learning characteristics help us to better understand why play supports learning in both social and academic domains. Zosh *et al.* (2018) note that characteristics such as actively engaged, meaningful, socially interactive, iterative, and joyful are frequently cited in the scientific literature as essential for optimal learning. These characteristics manifest collectively across activities, suggesting that playful learning, particularly guided play, offers benefits for both academic and other social outcomes.

Joyful learning can play a key role in children's cognitive development (Diamond, 2014; Betzel *et al.*, 2017). When children engage in enjoyable activities, the brain's reward centers are activated, and dopamine is released. This neurochemical reward is often experienced when challenges are met and solutions are achieved, providing a moment of satisfying accomplishment. In this way, LBB integrates Braille learning with the development of the stages of literacy (pre-syllabic, syllabic, syllabic-alphabetic, and alphabetic) in joyful and fun activities. This approach not only provides such educational benefits but also motivates children to learn through play and building games and toys.

Another essential feature of this approach is meaningful learning, which facilitates the assimilation of new concepts by connecting familiar experiences with previously acquired knowledge (Ausubel, 2003). For example, building a toy can incorporate strategies that are not only fun but also



promote the development and acquisition of new words or concepts. In this way, children associate what they are building with the names and contexts of the toys, which contributes to the absorption of new knowledge. This connection makes learning more meaningful and applicable to real-life situations, emphasizing the importance of LBB as a tool in the literacy process.

Active engagement in learning is maximized when children are deeply engaged in an activity and communicating through it (Zosh *et al.*, 2018). Using LBB encourages building and manipulating pieces, allowing children to explore and experiment with concepts in deep and meaningful ways. For example, by building toys, words, and sentences with LBB blocks, children develop fine motor skills (important for writing) such as grasping, manipulating, and fitting, while also developing some language structures:

- **Phonological Awareness:** Develops the ability to recognize and manipulate the sounds of spoken language by sounding out the parts and/or toys they build, recognizing and sounding out the sounds of letters and words. They learn how smaller units (letters) have meanings in forming a word, that is, how morphemes combine to form words;
- **Semantics:** They understand the meaning of words and expand their vocabulary by learning about the context in which these words are used and how words are related to form more complex meanings in sentences and texts.

According to Piaget (1962), iteration, which involves the conscious construction of new knowledge based on hypothesis testing and continuous revision of one's knowledge, is a distinctive feature of learning and play. Therefore, iterative learning is an important practice in children's literacy development. As they explore and experiment with new forms and approaches, children continually adapt and improve their play, games, and activities, strengthening the reward and memory networks in their brains. For example, by building a flower with LBB blocks in an initial form and then rebuilding it in a more refined form, children develop iterative thinking. They can then write the name in letters and Braille, associating each piece with a specific letter or word. At first, they simply assemble the flower by fitting the pieces together. They then rearrange the pieces to add labels with the LBB pieces that indicate the names of what they have built, both the whole and the parts of the flower, such as "petals," "stem," and "leaves. As they learn new words and concepts, children can modify and expand the garden with different flower shapes by adding a "sun," "clouds," or "butterflies" and labeling these parts. This iterative process builds fine motor skills and strengthens



language development by allowing children to experiment and revise their constructions with ongoing teacher guidance.

The socially interactive learning that occurs through play contributes to the development of social and emotional skills (Chi, 2009). Through play, children practice dialogue, learn to defend their ideas, ask and answer questions, and resolve conflicts. For example, when children build a toy as a team or participate in a team game using LBP pieces, they learn to work together, share, and make group decisions. For example, they can build a garden together, with each child contributing different elements, such as flowers, trees, or animals, and labeling the pieces with the name of each element constructed. Peer interactions in this context can enhance the play experience and provide social growth for children, in addition to strengthening literacy skills as they discuss and decide which words and concepts will be represented in their constructions.

The five characteristics of playful learning presented here will guide the analysis of the data from this research, the methodology of which will be detailed in the next topic.

3 METHODOLOGY

This is a documentary research that analyzed the PIEs developed and used during the training of educators for the use of LBB in the year 2023. Those responsible for developing the PIEs selected for analysis are regular classroom and AEE teachers. The training is based on the constructivist, contextualized, and meaningful (CCS) approach (Schlünzen, 2015; Schlünzen *et al.*, 2020). In this approach, technology is used to construct knowledge through tangible objects, such as the LBB resource, facilitating the development of children's cognitive and social skills with the mediation of educators. The approach is contextualized, as the projects and activities emerge from the realities of the trainees, and meaningful, as the teachers intentionally systematize and formalize the disciplinary knowledge constructed by the children according to the meanings attributed to the concepts and contexts. Following the principles of this approach, the programmatic content of the training of educators in the use of LBB is structured into three main modules:

- Inclusion of people with disabilities - This module addresses knowledge about VI, literacy, and mathematics education for children with this disability. The aim is to provide a solid

- knowledge base on the specific challenges and strategies for inclusive education of children with VI and to encourage educators to reflect on how this process takes place in their contexts;
- Braille and Visual Impairment - focuses on the Braille system, providing general ideas about its use and practices with LBB. This module is essential for becoming familiar with the tools and techniques needed to effectively integrate Braille into educational activities;
 - Strategic Intervention Plan - addresses the concepts of orientation and mobility and audio description, in addition to the preparation, implementation, and reflection on the development of the PIE. Based on the needs identified by educators regarding the inclusion of children with VI in their contexts, this module allows the development of practical strategies appropriate to their educational realities.

The training of educators for the use of LBB has been carried out in distance education mode since 2020, with synchronous activities on Tuesdays, from 19:30 to 21:30, with experts invited to elucidate the concepts and content covered in the modules, and asynchronous activities in the virtual learning environment (Moodle). As mentioned above, this training is offered by the FDNC in partnership with researchers from UNESP and UNOESTE, the universities where the authors of this article work. To develop the asynchronous activities, didactic-methodological strategies are used, such as discussion forums for reflection and debate on the content, pedagogical mediation carried out by tutors, and study materials, including videos, texts, and slides.

To verify the relevance and originality of this research, a search for the words "lego braille bricks" and "lego braile bricks" was conducted in the following databases Education Research Information Center (ERIC), Elsevier, Web of Science, and CAPES Periodicals Portal (federated access). Only one article was found, a Brazilian publication on the online training of educators from institutions specialized in VI, which took place in 2019 (Perez *et al.*, 2022). This fact shows the scarcity of research on LBB, despite its use in 30 countries.

Data collection was carried out on *Padlet*, a free, online collaborative resource, specifically on the page: <https://padlet.com/PeinCursos1/pr-ticas-compartilhadas-com-lego-braille-bricks-flobu2xk48domsi2>. Posting the PIE on *Padlet* is voluntary, as the evaluation takes place on Moodle. All files posted in this article are licensed under *Creative Commons*.

The analysis of PIEs followed the three chronological phases proposed by Bardin (2016):

pre-analysis, exploration of the material, and treatment of the results. In the pre-analysis phase, 174 PIEs published in 2023 were read, of which 48 were selected. The inclusion criteria were: development in the regular classroom, target audience of children between the ages of 4 and 10, and relationship to literacy, identified by keywords such as literacy, reading, and writing. Exclusion criteria included no relationship to literacy, no development in the regular classroom, a target population outside the specified age range, and no record of LBB use. After pre-analysis, the files were imported into the qualitative analysis software MAXQDA24, Analytics Pro version, and identified by numbers from 01 to 48.

In the material exploration phase, the files were read and coded using the structural method, in which data are coded if they contribute to answering the research questions (Mattar; Ramos, 2021). During the reading of the selected PIEs, codes were assigned in MAXQDA software to the words, images, or passages of the texts that represented their meaning. Chart 1 presents the codes used and their respective objectives.

Chart 1 - Labels for coding and their respective purposes

Codes	Objectives
Learning: <ul style="list-style-type: none"> • happy; • significant; • socially interactive; • iterative; • actively engaged. 	Identify the characteristics of playful learning present in PIE.
<ul style="list-style-type: none"> • regular education; • resource room. 	Identify the context in which the PIE was executed.

Source: Own elaboration (2024).

After coding, the analysis of the results considered the frequency of occurrence of the codes in the texts and their interconnections, the coded text passages, the notes made during coding, and the theoretical framework, returning to the original full texts when necessary. The next topic presents the documentary analysis of the PIEs.

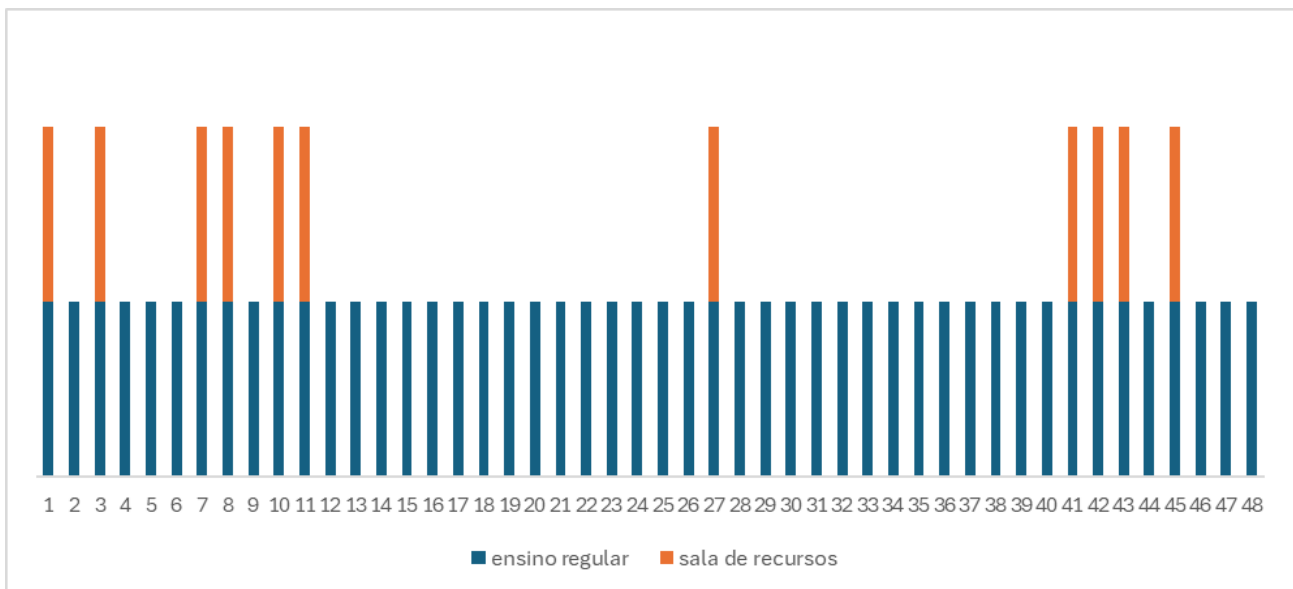
4. RESULTS AND DISCUSSION



The following results present an analysis of the characteristics of playful learning present in the activities of the selected PIEs. Based on a graph showing the distribution of codes in each file, figures and excerpts illustrate the characteristics found in the PIEs analyzed.

Regarding the context in which the PIEs were applied, in 11 cases the activities were carried out both in the resource room and in the regular classroom, which indicates a partnership between the AEE teachers and the regular classroom teachers. In the other cases, the regular classroom was the only place where the activities were applied, following one of the inclusion criteria of this study, as shown in Graph 1.

Graph 1 - PIE application context

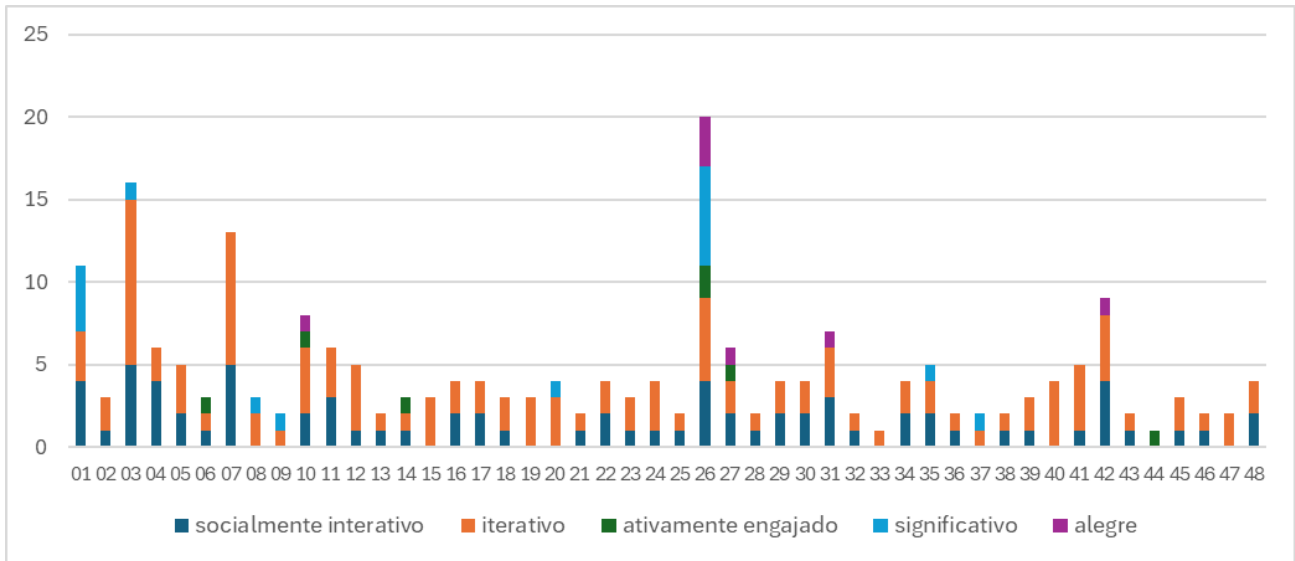


Source: Own elaboration (2024).

Considering the characteristics of playful learning, Graph 2 shows the distribution of codes among the PIEs analyzed. The analysis showed that the same activity could contain more than one of these elements. However, the excerpts and figures that best fit each aspect have been selected for discussion.



Graph 2 - Distribution of codes on the characteristics of playful learning



Source: Made by the authors (2024).

Graph 2 shows that the most common feature of playful learning in the PIEs is iterativity, as evidenced by the free use of LBB, which allows experimentation, error, and retry until the goal is achieved. The main topics covered in the segments with this code are playful and educational activities involving the use of LBB, emphasizing exploration for the construction of objects, writing names and words related to the topic covered in class, among others. Thus, this feature was observed in all the PIEs analyzed, as shown in Figure 2.

Figure 2 - Photos of children using LBB



Source: PIE 03 and 07.

In the first photo in Figure 2, the child has assembled the alphabet. In the following photos, the same child has filled the entire board with pieces, leaving no space. Considering that these are children who are still learning to read and write, this type of activity helps improve fine motor coordination, the ability to solve problems with planning and organization and promotes creativity.

For Piaget (1962), iteration is a fundamental process in children's cognitive development. This concept refers to children's ability to continuously learn and adapt through experimentation and adaptation. Iteration involves testing hypotheses, observing results, and modifying understanding based on new information gained. According to the author, through this process, children construct knowledge in an active and dynamic way, improving their cognitive skills and deepening their understanding of the world around them.

Piaget (1962) emphasizes that this conscious construction of knowledge is fundamental to intellectual development and occurs naturally during play, where children explore, experiment, and learn from their experiences. He emphasizes that iteration is important for the formation of mental schemas, which are cognitive structures used to organize and interpret information. As children interact with their environment, they constantly adjust these schemas to incorporate new experiences and resolve conflicts between prior knowledge and discoveries. This process, known as assimilation and accommodation, allows children to develop a greater understanding of the concepts and phenomena with which they are dealing. In addition to being present in the characteristics of playful learning, iteration is also an important mechanism by which children develop critical thinking and problem-solving skills, essential skills for facing more complex challenges as they grow and develop.

In analyzing the PIEs, it was observed that whenever the initial exploration or other teacher-directed activity was conducted in pairs or groups of children, the socially interactive feature was present in the activity, being the second most present feature in the PIEs analyzed. The analysis of the segments coded as socially interactive shows that the activities using the LBB, which include free exploration and construction, recognition and identification of Braille letters, ordering and sequencing of letters, in addition to writing names and making objects, when conducted in groups, promote interaction and collaboration among children, highlighting the importance of cooperation, especially for children with disabilities. Collaboration between groups was essential to the completion of the tasks, which benefited the development of the activities.

In cases where the PIE was applied in a context where a child with visual impairment was

included, it was not necessary to adapt the activities to meet their needs, as the LBB is an inclusive resource from its conception, ensuring the participation of all. Planning the activities within this approach promoted an inclusive educational environment where all children could actively participate regardless of their visual limitations. Thus, the activities not only stimulate learning but also promote inclusion and social interaction, as can be seen below:

We will work on the numerical sequence content in a different way, where each student in the group will have a number, they will have to share their number with each other and insert the DV colleague and organize themselves so that the numerical sequence is correct (PIE 02).

Figure 3 - Photo of children playing together



Source: PIE 42.

In Figure 3, five children joined the three bases of an LBB kit to build a street and a castle. This initiative demonstrates children working together and solves a recurring problem when teachers ask how to form groups of more than three children, given that the kit has only three bases. This activity develops social-interactive skills such as:

- Collaboration: By working together to create something bigger than they could individually, children learn to work together and share ideas;
- Communication: to act in a coordinated way and make decisions, they need to communicate;
- Conflict resolution: resolving issues related to disagreements;
- Negotiation: deciding how to use the parts and which parts of the project to build first requires negotiation and shared decision-making;

- Empathy: considering each other's ideas and perspectives, sharing responsibilities, and supporting each other.

Chi (2009) explains that interactive activities involve processes of attention and creation, in addition to adding a social dimension through dialogue. When children interact with their peers, these interactions are often characterized by joint dialogues in which both parties make substantive contributions to the topic under discussion, build on each other's contributions, defend and argue positions, challenge and criticize each other, and ask and answer questions. For the author, this activity is considered constructive because children generate knowledge that goes beyond the information provided.

The characteristic that refers to significant learning was identified when the planning included the activation of the children's prior knowledge and the teacher's mediation was present to help them make the connection between what they already knew and the new situations and concepts presented, as exemplified in the following excerpt.

The next day, Rosane (who used to be Lu's VI teacher) and Bruna welcomed Lu (who has a broken foot and is in a wheelchair) and her family so that she could have a moment to learn about and explore Lego. We talked a lot with the family about how important it was for Lu to learn Braille and how Lego would give her fun literacy moments. It was very moving when she opened the box and saw that they were Lego pieces. Lu explored the pieces and we showed her that there was Braille inside. We separated the pieces with the letters of the student's name and began to put them together. We wrote her name, her parents' names, and the names of her two sisters. We noticed that all the family members' names started with the letter L, including Lu's name. The student was able to recognize and find all the pieces that had the Braille of the letter L by touch. We were impressed by her dexterity with Lego (PIE 26).

The above report deals with teaching literacy to a blind child. The potential of LBB to be accepted by both children with VI and their families is clear. In addition, the teacher uses the knowledge the child already has about the first letter of his name to help him construct his name and the names of his family members. In the same PIE, significant learning is highlighted in six codes. This is due to the fact that all the proposed activities were based on a theme that was part of the children's context, referring to nearby places where they liked to play and to typical foods of the city. Thus, even the free constructions made at the beginning of the activity were already related to the theme.

Ausubel (2003) distinguishes between rote learning and meaningful learning, explaining that

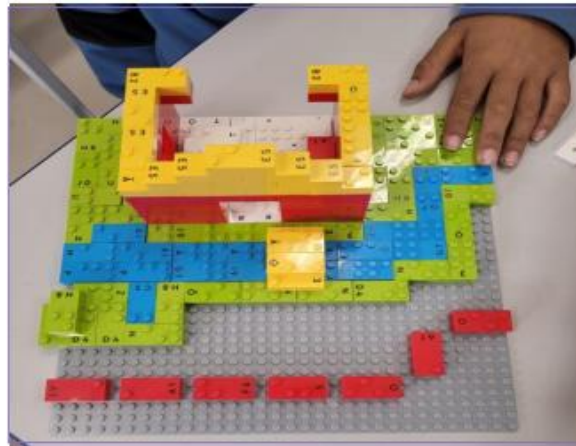
the former refers to the simple repetition and memorization of information without proper understanding or connection to the learner's prior knowledge. This can result in superficial and short-lived knowledge. On the other hand, meaningful learning occurs when new information is integrated with existing knowledge, creating a network of related concepts that facilitates deep understanding and long-term retention of content. Ausubel (2003) argues that this process contributes more to teaching and learning because it allows the development of the ability to apply what has been learned in different contexts. The following report gives an example of an activity carried out with a child with low vision who will lose his sight completely. Therefore, he is already learning Braille.

We started with the recognition of vowels and consonants [...] we used the student's name and the figures he had chosen beforehand, the student used his prior knowledge and only then did we intervene with the words that needed correction [...] we worked with all sorts of objects at hand, such as Lego Braille bricks, egg cartons, PET bottle caps, movable alphabet with figures, Braille alphabet on A4 paper, Braille alphabet printed in a larger size and glued to cardboard for better visibility (PIE 03).

The report clearly shows the use of other materials with which the child has already been in contact, as well as the use of his own name and characters chosen by him to write, giving him the opportunity to carry out the activity using his previous knowledge. Later, the teacher mediates so child reaches more advanced levels and makes learning meaningful.

Figure 4 illustrates the construction carried out by a child representing a story read by the teacher, in which the child is able to relate the concept of a castle presented in the story to his prior knowledge of the topic. This integration allows the child to build his/her castle, demonstrating the presence of meaningful learning.

Figure 4 - Child building a castle with the LBB



Source: PIE 42.

Finally, the characteristics of "active engagement" and "joy" were more challenging to identify in the written records, and were best observed in the PIEs that included video records. The video (https://www.youtube.com/watch?v=bEkboOWTm_4 (PIE 26)) demonstrates that the children were deeply involved in the proposal, allowing learning to occur in an engaging and joyful way. The report below shows the importance of moments of free exploration preceding moments of directed activities.

The students carried out all the activities with great enthusiasm. On each day that Lego was used, we set aside time for the "Material Exploration" activity, as we felt it was necessary, as the students were very excited and euphoric" (PIE 20).

Although play appears unrestricted, it requires focus and a balance of children's desires, as highlighted by Zosh *et al.* (2018). The authors emphasize that adult-guided play with specific goals maximizes engagement, which is essential for young children more susceptible to distraction. They argue that this structured activity promotes better cognitive development, emphasizing the importance of active engagement in learning. In the video, active engagement can be seen in the children's enthusiasm as they build something related to their context, such as clay pots, reflecting a deep and enjoyable involvement in the activity. In addition, the children are constantly moving, picking up, and putting together pieces, showing dynamism and continuous interest.

In terms of joyful learning, it is clear that positive affect is associated with better executive function and academic performance because a positive mood promotes cognitive flexibility, which is essential for learning and problem-solving. Such aspects were found in research conducted by Diamond (2014), who explains that when a person is happy, selective attention improves and positive mood is strongly associated with an increase in creativity. This allows people to work more flexibly

and identify potential relationships between concepts. Studies by Betzel *et al.* (2017) show that high levels of positive mood correlate with greater flexibility of brain networks, particularly in somatomotor regions, which are areas of the brain involved in planning, controlling, and executing voluntary movements. This increased brain flexibility is associated with superior cognitive performance and greater learning capacity, suggesting that emotional state can directly influence the effectiveness of learning. In the video, joy is evidenced by the children's smiles.

The analysis of the PIEs shows that the characteristics of playful learning are present in different ways in each of the files. Among these characteristics, iterative was more present in the PIEs, highlighting the importance of free use of the LBB to experiment, make mistakes, and try again. The results showed that the socially interactive feature is present when the activities are carried out in pairs or groups, where children have the opportunity to build something or solve a problem together. Significant learning was observed when the activity planning anticipated the activation of prior knowledge, and the teacher mediated the learning to help connect with the new concepts. The characteristics of "active engagement" and "enjoyment" were more present in activities that involved situations of directed play and free creation. These results indicate that the PIEs analyzed incorporate fundamental elements of playful learning that can contribute to an inclusive literacy process with the use of the LBB, considering the different stages of literacy experienced from 4 to 10 years of age, as shown in the following excerpt.

We would like to emphasize that this course was a great learning experience for us teachers and for the students, because in this short time of using Lego Braille Bricks, we noticed that there were significant progresses in the learning levels of some students, who began to recognize the alphabet and begin to read, and others improved in fluent reading, where they had not done so before (PIE 13).

The above excerpt adds to the other results presented that demonstrate the effectiveness of using LBB and its contribution to inclusive and playful learning. The strong presence of playful characteristics in the activities analyzed highlights the importance of allowing children to experiment, make mistakes, and try again, thus consolidating their cognitive and motor skills in an active and dynamic way.

The analysis revealed the importance of socially interactive activities that stimulate collaboration and communication among children, aspects that reinforce the inclusion of children with

disabilities and allow for an equitable learning environment. In addition, it was observed that meaningful learning was a fundamental component observed in the PIEs. By connecting new knowledge to previous experiences and family contexts, teachers were able to facilitate a deeper and more lasting understanding in students. The characteristics of "active engagement" and "joy" were also fundamental, demonstrating that a positive and engaging learning environment can significantly improve children's executive function and creativity. These findings highlight the importance of incorporating playful and inclusive pedagogical practices into the literacy process to benefit children's cognitive, social, and emotional development.

5 FINAL CONSIDERATIONS

The study of the PIEs identified several aspects that can be improved in the training of educators to use the LBB to promote playful and inclusive literacy. First, it is necessary to increase the time devoted to practical activities with the LBB in the classroom, allowing for a deeper reflection on its possible uses, with tutors monitoring and sharing experiences among colleagues. In addition, the activities should be carried out in the context of the regular classroom to promote inclusion, avoiding individualized practices, especially in contexts with children with VI. It is also important to create a space in the PIE to record reflections on the activities developed, as well as photos, to analyze whether the objectives were achieved. Another aspect that needs to be improved is the explanation of the choice of the PIE theme because when the theme is related to the children's context, it facilitates the connection between previous and new knowledge. The analysis showed that moments of free exploration of the LBB before proposing guided activities was a practice that calmed the children and favored playful learning. These notes are intended to contribute to the future training of educators in the use of LBB, both in Brazil and in other countries participating in the LEGO Foundation's global initiative.

Research on the characteristics of playful learning in PIEs has provided important insights for inclusive education, particularly in literacy. The findings suggest that educators incorporated elements such as iterativity, social interaction, meaning, active engagement, and joy in diverse and effective ways. Iterativity, highlighted as the most present feature, highlighted the fundamental role of LBB in promoting an environment of experimentation that allows children to construct knowledge in an active and dynamic way, as argued by Piaget (1962). Social interaction, especially in group or

pair activities, promoted inclusion and strengthened important socio-emotional skills such as empathy and communication. Meaningful learning was observed when educators helped connect new knowledge to children's prior knowledge. Active engagement and joy, evident in audiovisual recordings, reflect enjoyable and dynamic learning that promotes cognitive flexibility and better academic performance.

Analysis of the PIEs shows that incorporating the characteristics of playful learning can contribute to an inclusive and effective literacy process. The use of tools such as LBB supports the development of academic and cognitive skills and promotes an inclusive and collaborative environment, which is essential for the educational success of all children. In addition, the results show that the free use of LBB allows children to experiment and learn from their mistakes, stimulating social interaction and collaboration, which is fundamental to children's socially interactive development. The presence of meaningful learning mediated by teachers connects prior knowledge with new concepts, enriching the educational process. The active engagement and joy observed in activities with LBB demonstrate that learning can be fun and engaging, contributing to a more inclusive and equitable school environment.

The internationalization of education promoted by the LEGO Foundation through the global distribution of LBB, training, and dissemination of materials on how to use it according to the five characteristics of playful learning is seen as a significant contribution to the literacy of children with VI. LBB facilitates learning in a playful and iterative way, promoting literacy as well as the development of motor, cognitive, and social skills. The inclusion of these children in regular classroom activities without the need for special accommodations reinforces the inclusive nature of this resource. This way, LBB is a powerful tool for inclusive education, in line with the principles of equity and accessibility in global education.

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