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Quantities and Measurements in Early Childhood Education: an ethnographic analysis of young children's productions

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Abstract: This research aims to analyze the relationships and productions of mathematical thinking about quantities and measurements, based on a pedagogical space with a kindergarten class. To this end, an ethnographic field study was carried out with the participation of a group of children aged 4 and 5 and the first author (researcher and teacher of this group). As a result, we noticed children's mathematical productions associated with their lived experiences, which took place in contexts of symbolic games and the reproduction of social practices with instruments of magnitude and measurement. This shows the need to explore different ways of thinking mathematically in childhood.

Keywords: Mathematics Education. Childhood. Ethnography. Mathematical Thinking.

Grandezas e Medidas na Educação Infantil: uma análise etnográfica das produções de crianças pequenas

Resumo: A pesquisa tem por objetivo analisar as relações e produções sobre o pensamento matemático de grandezas e medidas, a partir de um espaço pedagógico, com uma turma de Educação Infantil. Para tanto, realizou-se uma pesquisa de campo de cunho etnográfico, em que participaram um grupo de crianças de 4 e 5 anos de idade e a primeira autora (pesquisadora e professora deste grupo). Como resultado, nota-se produções matemáticas infantis associadas com as suas experiências vividas, ocorridas em contextos de jogos simbólicos e a reprodução de práticas sociais com instrumentos de grandeza e medida. Deste modo, percebe-se a necessidade de exploração de diferentes formas de pensar matematicamente na infância.

Palavras-chave: Educação Matemática. Infância. Etnografia. Pensamento Matemático.

Cantidades y medidas en la educación infantil: un análisis etnográfico de las producciones de los niños pequeños

Resumen: La investigación tiene como objetivo analizar las relaciones y producciones sobre el pensamiento matemático de magnitudes y medidas, a partir de un espacio pedagógico, con una clase de Educación Infantil. Para ello se realizó un estudio de campo etnográfico, en el que participaron un grupo de niños de 4 y 5 años y la primera autora (investigadora y docente de este grupo). Como resultado, se destacan las producciones matemáticas de los niños asociadas a sus experiencias vividas, ocurridas en contextos de juegos simbólicos y de reproducción de prácticas sociales con instrumentos de magnitud y medición. Por ello, vemos la necesidad de explorar diferentes formas de pensar matemáticamente en la infancia.

Palabras clave: Educación Matemática. Infancia. Etnografía. Pensamiento Matemático.

1 Introduction

Early Childhood Education has sought to overcome the vision of providing assistance and merely preparing for the future. In this context, the Mathematics Education that is present there is structured, or at least should be, as a possibility for the integral formation of young children.

The Mathematics Education we consider for this stage is built on exploration, play, research and child discovery. Among the discussions produced, we see mathematical thinking linked to quantities and measurements as a means for this construction.

In this sense, this paper aims to analyze the relationships and productions of mathematical thinking about quantities and measurements, based on a pedagogical space with a kindergarten class.

2 Theoretical reference

2.1 Views on childhood

This study starts from the perspective of the sociology of childhood. In this, a Pedagogy of Childhood is projected, since it conceives of children as capable social actors, with agency and autonomy, as subjects of rights with their own concerns, opinions, desires and needs and not just as beneficiaries of protection measures (Sarmento, 2009). Children are seen as producers of culture and childhood as a social construction/category (Qvortrup, 2010).

A Pedagogy of Childhood creates possibilities for pedagogical action that reflects the legitimacy of the body in movement, gestures, voice and the child's competence in producing and participating in their culture (Camargo, Garanhani, 2020). In addition, reductionist and conservative models are criticized in the dichotomy of education/teaching, production/transmission of knowledge, experiences/experiences/classroom and children/students (Tomás; Ferreira, 2021). Practices such as these must be decolonized and reframed in light of the meaning of the child's agency and their rights (participation, provision and protection) (Camargo; Garanhani, 2020).

Sarmento (2007) and Corsaro (2011) criticize Piagetian theories, the dominant thought of socialization, which are based on the existence of a linear, progressive and standardized logic of development, placing the child as the object of the process and hiding childhood. It therefore highlights the need to strip away historical and civic (in)visibilities based on studies that reinforce the idea of the incompleteness and imperfection of children and childhood. From this perspective, we want to move away from studies on schools or families, in which children are "children" or "pupils", towards a conception of children with their cultural and social relationships, as well as presenting studies with children and not about them (Marchi, 2011).

Although the terms "child" and "childhood" are understood as synonyms, it is important to consider that they take on different roles and concepts. Anthropology and Sociology of Childhood studies make a distinction between the concept of child and childhood. Childhood is seen as a social category that changes historically and children as social actors in their ways of life (Marchi, 2011; Kramer, 1999).

In this sense, childhood is seen as a structural category, that is, a social structure that has no beginning or end, it is a permanent category of any generational structure. Childhood is not a natural phenomenon, but a social one. Children grow up, but childhood remains a structural category in society (Qvortrup, 1993).

Thus, a children's culture emerges, “a culture made up of cultural elements that are almost exclusive to the immature and characterized by their current playful nature” (Fernandes, 2004, p. 215). According to Sarmento (2021, p.182),

> Children's cultures are made up of the symbolic processes through which children weave the threads of meaning with which they interpret the world and establish the basis for their interactions with other children and adults. Although deeply embedded in societal cultures and built through socialization with reference adults (mainly parents and teachers) and peer socialization, children's cultures have specificities and unique characteristics in their forms (language, games, cultural practices, rituals, etc.), in the processes of signification, in communication protocols and in the internal articulation of their elements. These specificities are drawn within the framework of a profound cultural diversity and are expressed within the “forms”, “circles” or “spheres” of children's interaction (the family, the school, the community, the nationality, global culture), being expressed in children's relationships with each other and with society.

Based on this concept, ethnographic research was carried out with cultural content produced only by children, thus highlighting peer culture, cited by Corsaro (2011, p. 128), “[...] as a stable set of activities or routines, artifacts, values and concerns that children produce and share in interaction with others”.

2.2 Quantities and measurements in Early Childhood Education

Early Childhood Education goes beyond mere care, “educational assistance” (Kulhmann Júnior, 2000, p.04), or preparation for the future (Moraes, 2021a; Kishimoto, 2007). In this sense, educating children is linked to the concept of children as historical and social subjects (Brasil, 1998), based on their culture of interactions and play (Brasil, 2010) and the promotion of experiences (Brasil, 2017).

Thus, if we consider the research age group of young children, the name given by the National Common Curricular Base - BNCC (Brazil, 2017), we notice the presence of quantities and measurements, the object of this research, in the field of experience “Spaces, times, quantity, relations and transformations” (Brazil, 2017), in the following learning objectives (Table 1):

Table 1: Quantities and Measurements for young children

Learning Objectives
(EI03ET01) **Establish relationships** of comparison between **objects,** observing their properties.
(EI03ET02) **Observe and describe** changes in different materials resulting from actions on them in experiments involving natural and **artificial phenomena.**
(EI03ET01) **Establish comparative relationships** between objects**, observing their properties**
(EI03ET04) **Record** observations, manipulations, and **measurements**, using multiple languages (drawing, recording by numbers, or spontaneous writing) on different media.
(EI03ET07) **Relate** numbers to their corresponding **quantities** and identify before, after, and between in a sequence.
(EI03ET05) **Classify objects** and figures according to **their similarities and differences**.
(EI03ET08) **Express measurements** (weight, height, etc.) by constructing basic graphs.

Source: Prepared by the authors (emphasis added).

Table 1, analyzing the notions of quantities and measurements with young children, shows that the action verbs are: demonstrate, act, communicate, value, create and express. The objects are: independence, limitations, body, idea, sensations, emotions, possibilities, movement, experiences, quantities and measurements. With young children, relationships with

quantities and measurements reflect greater autonomy; they already classify, recognize and express. Here the children master the notions even though they are not working with mathematical concepts. It can be seen in Early Childhood Education that “mathematical terms” are commonplace even though they don't make up the mathematical concept. According to Cavalcanti (2010, p.34), “children, in their daily lives, even before attending school, take part in activities that establish comparisons and use expressions where we can see the presence of notions related to quantities and measurements”.

Some concepts, such as measurement, only develop after the construction of notions of conservation, when the child is around seven years old. However, children come into contact with the terms “heavy”, “light”, “big”, “small”, “bigger”, “smaller” and experience sensations through games and play as early as Kindergarten (Cavalcanti, 2010).

In order to stimulate discussions about the Early Childhood Education curriculum and the notions of quantities and measurements, or the notion of measure, as proposed by Lorenzato (2006), we start with some discussions about mathematical thinking. According to Clements and Sarama (2009):

> In early childhood, mathematical foundations are built through exploration, experimentation and active discovery. By creating an environment rich in mathematical stimuli and learning opportunities, we can nurture the natural development of children's mathematical thinking from their earliest years.

In this sense, Moura (1995) brings these conceptions of children's mathematical discoveries through experimentation. According to the author, children can encounter measuring situations both inside and outside of school, which is why measuring at school should enable active exploration of the real world.

> In real life, measurement arises from the many demands to control variations in the dimensions of objects, especially in construction, artistic productions, moving around, it arises from the need to estimate values and measurements, it is present in shopping, cooking, science, sports, indirectly in reading tables, graphs, maps, standardized test scores and others. It is in everyday relationships that measurement seems to be impregnated with the cultural meanings of the human relationships it represents and communicates, just like beauty in art and architecture, balance in engineering, the communication of social phenomena in statistics and others. From an educational point of view, it is interesting to note that as a source of communication it can serve as a means of manipulating the truth of social phenomena (Moura, 1995, p. 43).

Thus, it can be seen that the experiences that take place in childhood are of great importance for future learning, because it is in these experiences that children express themselves, participate and understand the world around them (Corsaro, 2011). In this context, Clements and Sarama (2009) point out characteristics and principles associated with mathematical thinking that can enhance mathematical education in childhood:

a) *The integration of mathematical concepts*: integration of mathematical concepts in all areas of the curriculum and in all children's daily activities, instead of treating mathematics as a separate subject.

b) *Progressive development*: The activities are designed to follow a natural progression, starting with simple concepts and gradually moving on to more complex ones as children develop their mathematical skills.

c) *Use of concrete materials*: an approach that emphasizes the use of concrete manipulative materials, such as blocks, counters and puzzles, to help children visualize and understand abstract mathematical concepts.

d) *Problem solving*: Problem solving is an essential part of mathematical learning. Children are encouraged to actively tackle mathematical challenges, exploring solutions and strategies.

e) *Building concepts*: active construction of mathematical concepts by children, as opposed to an approach based on the transmission of knowledge.

f) *Inclusion and diversity*: values diversity and inclusion, recognizing that children have different learning styles and cultural backgrounds, and adapts activities to meet the needs of all students.

In this sense, there's no reason to insist on the idea that "it's too early" for mathematical thinking, since most children who start kindergarten know how to count, recognize some shapes, make patterns and use non-standard units of measurement.

3 Methodological path

As an epistemological paradigm, the research was based on the sociology of childhood, which led to the use of ethnography as a research method (James; Prout, 1990). For this choice, we considered Delalande's notes (2021), which emphasize that:

> Conducting research with children requires us to overcome our adult-centrism by considering children as social and cultural groups and not just as subjects to be educated. Ethnographic research based on immersion in the "field" allows observations and interviews to be carried out, and the way in which data is collected is inseparable from the scientific representation built up about the group under study. Thus, recognizing children as a social and cultural group implies not only observing how they act, but also how we act with them, how they socialize and how they are educated. Children are individuals who participate in the production of social relations based on their status as minors dependent on adults in emotional, economic and social terms (p. 243).

Ethnography is more than a method, it's a way of thinking about research, which allows you to enter the child's daily life, participating in all the constructions and productions in this environment, rather than creating an artificial environment with plasticized situations to collect pre-established data.

For Corsaro (2011, p. 63), ethnography is "an effective method for studying children because many features of their interactions and cultures are produced and shared in the present and cannot be easily obtained through reflexive interviews or questionnaires". Therefore, ethnography is a field of possibilities and self-knowledge, as it demands that the researcher is also open to the unexpected.

The subjects of the research are a group of 4 and 5 year old children and the first author (researcher and teacher of this group), from a Municipal Early Childhood Education Center in Ponta Grossa - Paraná. It is worth noting here that the children's guardians signed the Free and Informed Consent Form (FICF) and the children signed the Free and Informed Assent Form (FACF). This is because the child's permission is essential for the research to be carried out (Kramer, 2002).

The instruments used to produce data include the construction of a "pedagogical playground", based on the Freinet Pedagogy, on quantities and measurements. This consists of

a space with materials for children to use and explore the subject. This included a tape measure, a scale, a ruler, larger and smaller pots and beans on a tray.

We also used (1) a field diary produced by the first author to record facts and reflections on the research; (2) photographic records, as elements to relive memories and elucidate new ideas; (3) video and audio recordings, as a strategy to foster considerations about the research.

However, based on the principles of ethnography, the research is not restricted to what happens in the pedagogical corner, but also to the experiences that take place in the spaces of the CMEI. Thus, the data was analyzed in a descriptive and analytical way, seeking to follow the facts that occurred, creating inferences and reflections on the objectives of this research.

4 Results and Discussions

4.1 Behold, a Star Group is born

The Star Group emerged from the children's interest in the symbol. Over the course of a week, we explored various elements using books, magazines and toys. During this time, the children began to identify with some of the symbols and we[1] sorted them out so that later on we could put the chosen ones together and vote on them. One afternoon, after snack, we sat on the carpet and *Helô*[2] brought out a story book to tell: *How to catch a star* by Oliver Jeffers (Figure 1). The story generated a lot of conversation and the star was another symbol in the selection of symbols for a future vote.

Figure 1: Book - How to catch a star.

Source: First author's collection.

The children were playing on the lawn, their favorite place (Figure 2).

Figure 2: Playing on the lawn

Source: first author's collection.

[1] At certain points in the text, the person is changed: the first person plural is used when referring to the group's associations and the first person singular is used for the researcher's reflections.
[2] The children were given fictitious names/symbols based on their choices.

I remember sitting next to some children and asking them how they defined their class:

Skateboarder: *Look, profe, I think we're pretty cool, we like to play, do activities, play on the lawn, play with play dough, learn about skateboard maneuvers.*

Doll: *We're fun, sometimes we fight, but we "apologize" and everything's fine. We like to play the chair dance, but there are some people (pointing to a colleague) who don't like to lose.*

Lion: *We like to play, but it's better out here because there's more space to run and jump.* (TP)[3]

With these statements, I realized that the children are aware of their individual preferences and those of their group, detaching themselves from the rules and tensions of the adult world, which doesn't realize that they make decisions. In these questions, I recall Corsaro (2001) with his concept of peer relationships, in which children present their preferences and openly express their thoughts, without fear of being punished. The group's willingness to speak up and express their thoughts, ideas and desires, in a way, gives me a feeling of comfort, because we have built a space for participation and listening.

While observing the children's speeches in this episode, I dare to take another look, where it is possible to see elements of mathematics, when Lion says*: We like to play, but out here it's better because there's more space to run and jump.* Moura (1995) talks about the experience of discoveries "in real life", the perception of spaces and how children learn mathematical notions. When Lion justifies that there is more space on the lawn outside the classroom, indirectly there is a perception of magnitude, it is bigger, there is more space, and the child says that this space is "*better*". Cavalcanti (2010, p.34) reaffirms this idea: "children, in their daily lives, even before attending school, take part in activities that establish comparisons and use expressions where we can perceive the presence of notions related to quantities and measurements".

4.2 Who is mathematics?

On a very rainy day in May, many children were absent. The five who came to our meeting began to set up a little market in a corner of the living room table to sell their "products"/toys to their classmates. Taking advantage of the atypical day, I continued organizing other things in the room, without paying much attention to the children's movements, while something was happening in the room (Figure 3).

Figure 3: A game in the living room

Source: first author's collection.

After a few minutes, I realized I was playing social roles. Colussi and Szymanski (2019, p.3) define "the term 'social role play' to designate unstructured children's play, with implied rules and defined roles, through which children reproduce adult social roles in order to fit into society". I watched from afar and wrote down how the "game" would take place. Then they

[3] Transcrição parcial.

remembered that there were some fictitious banknotes in the basket in the living room and began to simulate buying and selling.

Puppy: *Hey, man, I need a pet to take to my granddaughter, and a donut.*

Skateboarder: *Yes, ma'am, would you like anything else? This dinosaur is on sale.*

Puppy: *I can't, that's all I have, otherwise I'll spend it all and be left with nothing.*

Skateboarder: *Let's see how much you have... (he put the notes together). Well, you can take the dinosaur and there'll be some change left over.*

Lion: *I'd like to buy a giraffe and a cup of coffee.*

Skateboarder: *Here, that'll be thirty reais.*

Lion: *Here it is (money on the table). I used the mathematics in my head and gave you the money. (He gave a bit of money and kept the rest in his hands).* (TP)

I approached the table when I heard the Lion say the word "math" and asked:

Teacher-researcher: *What math did you use, Lion?*

Lion: *The one we use to make bills, pay for things in the stores, in the market.*

Skateboarder: *I also used math to sell, this lollipop is worth twenty reais, who wants to buy it?* (TP)

On that rainy morning, the play between the five children lasted a long time, at least for the adult-self. I considered it to be a relevant amount of time for the children who performed symbolic play, imitating adults when they are in a supermarket. It may not have been that long. I went on to reflect on how logical thinking is built through experiences.

> Mathematical learning is built on children's curiosity and enthusiasm and grows naturally from their experiences [...]. Appropriate mathematical experiences challenge children to explore ideas related to patterns, shapes, number and space in an increasingly sophisticated way (Piaget, 1976, p.73).

Thus, for children, one of the ways of expressing what they already know is through play, building meaningful learning possibilities by exploring and becoming aware of what they are aiming for. When I saw that Lion *used mathematics*, I realized that the children experience these situations in their routine. One example is when Lion gave only part of the money he had, leaving a little in his hands. In other words, at some point in their social lives they must have experienced similar situations.

In this way, mathematical discoveries should be based on experiences and situations that permeate children's daily lives, in a way that makes sense to them and not as isolated content (Pozzobon; Andriguetto; Moraes, 2021). But who is mathematics anyway? For Moraes (2021b), it is a monster that gives us goosebumps, passions and provocations. "Who wants to meet a monster? At first, I don't think anyone. However, avoiding the encounter is not the same as denying its existence" (Moraes, 2021b, p. 58).

What we do know about this monster is that we can't deny its existence, but running away from it isn't an option either, at some point in our lives it will catch up with us. Moraes (2021b) proposes a "Larrosian" encounter of being with this monster, creating intimacy, bonds,

affections... “Those who pass through us, touch us, happen to us and are not mere passing information, incapable of leaving any trace. Who knows, maybe we'll give ourselves over to the experience, that is, to the beauty of the singularity of our own monsters” (Moraes, 2021b, p. 59).

When looking at the math monster in Early Childhood Education, one sees practices and research based on psychologizing theories of learning, along cognitivist lines (Moraes, 2021a). According to Moraes (2021a, p.77), these Brazilian studies are:

> [...] based and interested in the didactic-pedagogical processes of teaching in the classroom than in a theoretical discussion about Early Childhood Education. Thus, researchers who wish to carry out this theoretical undertaking [more social approaches] need to seek support in theorizing about childhood and its diversity of understanding throughout human history, which is not yet significantly present in Mathematics Education.

In this sense, seeking mathematics for children, we think of mathematics education from a childhood-experience perspective (Leite, 2011), from the experiences of the world that only exist in this childhood space. We strip away the constructivist approaches, which think of the child as an active subject in the school space, to think of this child as a producer of culture from the perspective of the Sociology of Childhood, as proposed by Corsaro (2011).

In this way, we are aiming for mathematics as a cuddly monster for early childhood education, not one that causes us fear and chills, but one with which we create possibilities, passions and affections. In this space of experience, in addition to mathematical thinking, there are mathematical cultures in children's cultures (Moraes, 2021a), as Lion showed us in the previous episode. In other words, there are children's cultural and identity creations in the encounter between children and adult-centered mathematical tools and ways of life.

The experience of quantities and measurements

On March 10, we started a teaching space inspired by Freinet (Figure 4), which was set up in the classroom with various measuring materials for a week.

Figure 4: Space for Mathematics

Source: First author's collection.

When they arrived in the room, the children went straight to the prepared space and began to manipulate the objects. The aim was to observe how the children experience these instruments and create ideas from them (Figure 5):

Lion: *Look at this one, skateboarder! Let's use it somewhere and see if my idea works out.*

Teacher-researcher: *Tell me your idea?*

Lion: *Look what we can do! A scale here in the window, let's see if we can pick up the toys and see which is down (heavy) and which is up (light).* (TP)

Figure 5: A scale

Source: First author's collection.

Teacher-researcher: *Wow, but did you already know that you could weigh using just these cups? How do you know it won't go wrong?*

Lion: *I already knew because I saw it on YouTube, so we put it in a still place and put something in it, look, I'm going to use the animals.*

Teacher-researcher: *Which of these two is heavier?*

Lion: *The bird weighs more than the elephant.*

Teacher-researcher: *But what do you mean? Isn't there something wrong?*

Lion: *Ah profe, it's just that they're made of plastic, and this little bird fools us because it's small, but it's heavier.* (TP)

We realized that the notion of the magnitude of mass was observable and palpable for Lion, who quickly noticed that the little bird was heavier, even if it was small, because it was a miniature iron. For Clements and Sarama (2009, p. 25):

> In early childhood education, children learn about quantities and measurements not only through abstract concepts, but through practical experiences and meaningful interactions with the environment around them. By manipulating objects, comparing sizes and quantities, and exploring spatial relationships, they build a deep and meaningful understanding of the mathematical world around them.

Lion initially already had some knowledge of the material, having seen it on *YouTube*. This makes us reflect on the use of technology, as access to and use of the cell phone allowed him to assimilate the use of the instrument he was shown more quickly.

Unicorn and Doll also liked the mass capacity instrument and soon began to explore it (Figure 6).

Figure 6: Instruments and news.

Source: First author's collection.

Doll: *Look Unicorn, take this thing to see the kilos so we can see ours!*

Unicorn: *Let me climb on top and see what comes up. There are some numbers down there, in the pharmacy the numbers are at the top, and they're red, this one is black. Teacher, what's going on there, it's marking one and five, is it fifty?*

Teacher-researcher: *It's marking your weight, which is... (suspense) 15 kilos. (Laughs)*

Doll: *Don't worry Unicorn, you're tiny and skinny.*

Unicorn: *I thought this weight scale was lovely, my mother would like it, but she doesn't even like going to the pharmacy.* (TP)

A few minutes later, they became interested in another instrument, the tape measure (figure 8). They started looking at it and then got out of their seats to measure some objects in the room (figure 9). No instrument was new to the children, not even their functionality. It's these relationships with the world that children experience outside the institution that make it possible for these elements and practices to become mechanisms for conceptual constructions.

Figure 8: The tape measure.

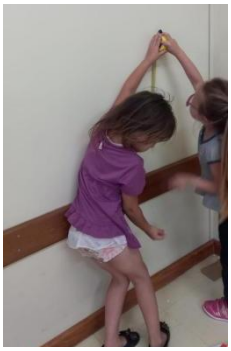


Figure 9: Exploring the tape measure

Source: Collection of the first author.

Doll: *Shall we measure some things, Unicorn? I know this one because I have it at home, my dad uses it when he's cutting something and it needs to be straight.*

Unicorn: *Wow, but there are so many numbers here, look at the amount of stripes and "numbers", it must be difficult to know, I can still see with my glasses.*

Teacher-researcher: *And you, Unicorn, did you already know this tape measure?*

Unicorn: *Yes, but I'd never picked it up to use, they don't let me.*

Teacher-researcher: *But do you know what it's for?*

Unicorn: *Yes, we hold the end of it, pull it and see how big things are, but I can also see by eye, look, I'll show you. He pulled some of his classmates to see who was the biggest and smallest among them (Figure 10).* (TP)

Figure 10: Major and minor

Source: First author's collection.

Unicorn: *Look, teacher, let's sort them out here. She organized the children and put them in ascending order. [...] "So" seeing your order, this is how it's organized, remember how sometimes we line up and the smallest goes first?*

Teacher-researcher: *I've got an idea, how about drawing a picture? I'm going to get a big piece of paper and I'll be right back.* (TP)

After returning with the roll of kraft paper, the children already knew what they could do.

Children: *Yaaaaaaay! Drawing!!!!*(Figure 11) (TP)

After placing the roll on the floor, each person took a piece to draw a classmate. There they talked about who was bigger and who was smaller.

Figure 11: Yaaaaay! Drawing.

Source: First author's collection.

During the week, we also did an outdoor activity and a cooking class, in which the children participated in the preparation, seeing the quantity of each ingredient.

4.3 Correct "Measurement"

There we were, in our favorite place: the lawn! The group decided we would play musical chairs. They organized themselves quickly and independently, grabbed the chairs, and headed for the lawn.

Lion: *Arrange the chairs! They have to be in a circle.*

Skateboarder: *Teacher, put some music on your phone.* (TP)

The music played and stopped, the children gradually stopped playing, picked up their chairs, and sat down next to me. The song *Pão de queijo - Bolofofos* began to play, and the children danced around the chair, singing along loudly, paying close attention to the next pause. In this context, another dialogue began

Chameleon: *Wow, now I'm hungry! My grandmother makes a really thick and delicious cheese bread, just like in the song.*

Doll: *I've tried it too. My aunt makes a really yellow one that's really stretchy.*

Chameleon: *My grandmother's is yellow too, because she puts egg in it. That's why it's yellow.*

Skateboarder: *I love cheese bread too. How do you make it?*

Chameleon: *My grandma uses a big bowl to make it because my uncle has a sweet tooth. She mixes a few ingredients together. If I remember correctly, it's eggs, flour, milk, and something else that makes it chewy.*

Skateboarder: *Teacher, how do you make cheese bread?*

Chameleon: *That's what I told you, right, teacher?*

Teacher-researcher: *That's right, Chameleon, we have some ingredients that are part of the recipe. For everything to work out, we need to follow the steps.*

Skateboarder: *Is what Chameleon said right?*

Teacher-researcher: *Shall we look it up on the internet? I don't remember what the ingredients are or how much of each one to use.*

Chameleon: *That's right, teacher, my grandmother uses a cup with numbers to measure, because once she made it and it turned out bad, like gelatin.*

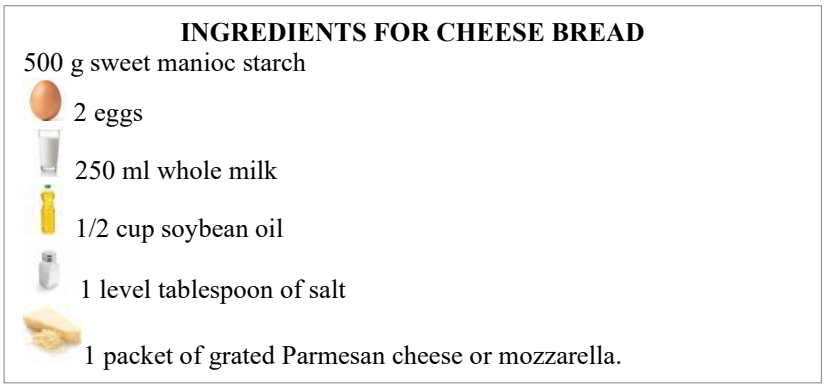
Researcher: *But what did she do wrong?*

Chameleon: *I think she didn't put enough milk in.* (TP)

In our research, we noticed that some movements happen naturally, while others stem from intentionality/provocation on the part of the teachers. Chair dancing and a craving for cheese bread are examples of these happy occurrences. The day after the chair dancing episode, I brought some pictures and a printed recipe for cheese bread for the students to read.

Teacher-researcher: *Well, as agreed, I brought the cheese bread recipe for you to read, so you can see what the ingredients are:* (Everyone listened attentively, and I began to read). (Figure 12). (TP)

Figure 12: Cheese Bread Recipe



Source: First author's collection.

After reading, I noticed Helo and Boneca whispering to each other, and then:

Helo: *Teacher, it's not difficult to make, is it? Boneca and I would like to make it with you, since only adults can use the oven.* (TP)

At that moment, excitement filled the room, everyone wanted to eat the cheese bread they had made. It was difficult to control the group's excitement.

Chameleon: *I can be your assistant today, because I know a lot about this.* (how to do it).

Teacher-researcher: *Okay, let's get organized, because we need all the ingredients and measurements just right so that it turns out delicious. How can we do that?*

Skateboarder: *We can check with Aunt Neusa to see what she has. I think she has everything! Only this* (pointing to the sweet sprinkles) *I'm not sure we have, I've never seen it before.*

Researcher: *And how can we measure the ingredients?*

Chameleon: *Teacher, teacher, I'll ask my grandmother to lend us her measuring cup.*

Helo: *Yeah, my mom has those measuring spoons too, she uses them to bake cakes.*

Researcher-teacher: *Then it'll work out, I'll check the ingredients and we'll set a day to make it.*

Boneca: *How about the day after tomorrow, teacher, that's soon enough.*

Skatista: *Yeah, it'll be really cool, Chameleon!* (TP)

Children regard agreements as "laws," which is why it is important to propose activities and organize the next steps in advance, so that actions are not lost along the way. The good news was that we would be making the much-desired cheese bread.

Research professor: *I have good news, we're going to make cheese bread today.*(TP)

Everyone started celebrating and getting excited.

Research professor: *So, we'll have to go wash up and head to the cafeteria, because you'll be the chefs.* (TP)

When we arrived at the cafeteria, all the ingredients were laid out on the table, but there was three times as much as the recipe we had discussed in class (Figure 13).

Figure 13: Chefs of Cheese Bread

Source: collection of the first author.

Helo*: Wow, that's a lot! Wasn't it just two eggs?*

Doll*: Isn't that a lot of milk, teacher?* (There was a 1-liter carton.)

Chameleon*: Ahhh* (puts hand on chin) *that's because the teacher is going to make a looooot of cheese bread.*

Researcher-teacher*: That's right! We'll need a lot more for the recipe to turn out well and for everyone to eat.*

Skateboarder*: So, let's make some delicious cheese bread.*

Chameleon*: Teacher, I'll give you a hand, like I saw my grandma do. I'll help you.* (He picked up the measuring cup I brought from home and looked at it). *Where is the mark where we put the milk?*

Researcher-teacher*: Here, but we'll have to use it twice.*

Chameleon*: Okay, I'll put it in.*

Skateboarder*: Ahh, I see, the teacher is going to make a lot.* (TP)

After mixing the ingredients, the children noticed the "double" when adding extra ingredients (Figure 14).

Figure 14: Can I mix it?

Source: First author's collection.

Researcher: *Well, now that everything is mixed together, let's put it in the pan and bake it.*

Helo*: Will it take long?*

Chameleon*: I think about an hour, the professor made quite a lot.*

Researcher: *I think about an hour! The oven here takes a little longer to heat up.* (TP)

After removing the pan from the oven, the children decided to eat in the living room. It was a wonderful moment. They named it "star cheese bread" because it was *so delicious*! Many said they would teach their parents how to make it at home and that it was easy if you used the right measurements.

In this episode of "correct measurement," we noticed reflections that corroborate Corsaro (2011), Cavalcanti (2010), and Moura (1995), since children's reflections and inferences arose from the group's games and interactions, through experiences and the sharing of cultures, which allowed for new discoveries.

Furthermore, it is interesting to see how content is not presented in isolation in early childhood education (Moraes, 2021a). We can see the first movement of mathematical culture already taking shape in:

> **Lion***: Arrange the chairs! They have to form a circle.* (TP)

It was not necessary to plan a specific moment or lesson to work on the concept of circles in isolation (Leite, 2011). Although this was not the intention, it is clear that children already acquire these elements through their experiences.

> **Chameleon***: My grandmother uses a large bowl to make it because my uncle has a big appetite.* (TP)

Returning to Cavalcanti (2010, p. 34), "children, in their daily lives, even before attending school, participate in activities that establish comparisons and use expressions where we can perceive the presence of notions related to measurements and quantities." When Chameleon says "big bowl," he already presents this notion of big/small, larger/smaller in relation to the bowl, analyzing it with the term "greedy," since if it were a small bowl, it might not be enough for his uncle. And all these other movements in the child's speech, in *"Can I ask? I'm going to use the cup, what size, how many do you need? Which mark?"*.

In this sense, we realize that the surveys by Cavalcanti (2010), Moura (1995), and Corsaro (2011) justify peer relationships, social relationships that children have in their daily lives. They are participants in a life outside an institution, so their discoveries have much greater dimensions. It is becoming increasingly simple and practical to note that mathematical culture in childhood "is made by doing." Thus, by learning about instruments of magnitude and measurement and manipulating them in everyday life, children learn to measure and weigh by measuring and weighing.

5 Final thoughts

This paper aimed to analyze the relationships and productions of mathematical thinking about quantities and measurements from a pedagogical space with a class of early childhood education students. To this end, ethnographic-inspired research was conducted with a group of children and their teacher (also a researcher).

The results show that mathematical productions are directly associated with the children's experiences in their primary communities (family) and with the digital world (YouTube). For example, they already make comparisons and take decisions based on these.

Furthermore, it is clear that mathematical practices are part of children's symbolic games. In these games, mathematics is not seen as something monstrous, but rather as a means

of reflection and socialization. As for instruments of magnitude and measurement, children demonstrate that they know how to use them and draw inferences from them.

Finally, it is considered that future research needs to open the Pandora's box of magnitudes and measurements, reflecting on parameters, measurements, and ways of thinking mathematically about the world and immediate reality.

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