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Anthropomorphism in the experimental activities' illustrations of the magazine Ciência Hoje das Crianças[+*]

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Abstract

This study mapped and characterized the anthropomorphic aspects of 434 illustrations in 196 experimental activities in CHC magazine from 2009 to 2020. As a theoretical contribution, we used the Bachelardian framework for its potential to provoke critical reflections on the analysis of materials that publish scientific information. The methodological approach is qualitative and documental, and the analysis used a triple-blind verification process. The results show that the magazine does not rely mainly on this resource to attract readers since no anthropomorphic features were found in more than two-thirds of the experimental activities. There are few studies on anthropomorphism in physics teaching, which we consider a gap in the area, nor are there any studies with children. Even though there is no consensus on the impact of these representations on the construction of scientific concepts, it is important to highlight their presence in materials present in schools. Therefore, the field of science teaching research in Brazil must look at dissemination materials to generate results that help teachers use them to build scientific concepts with students. As a prospect for future research, it is

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crucial to investigate anthropomorphic features in the other sections of the magazine and directly with students, proposing reflections on the limits and possibilities of this visual resource for the construction of scientific concepts.

Keywords: *Scientific Divulgation; Epistemological Obstacles; Science Education.*

I. Introduction

The magazine Ciência Hoje das Crianças (CHC) was created in 1986 by the Sociedade Brasileira para o Progresso da Ciência (SBPC), initially as an insert in the periodical Ciência Hoje (CH) and, in 1990, it became an independent publication. On its website, CHC reports that "60,000 public schools in Brazil receive the magazine in their libraries. This means that, as well as informing and entertaining, the magazine is a source of research for thousands of students and teachers"[2]. The CHC website states that its aim is to arouse children's curiosity about various science topics, "to show that science can be fun and that it is present in all of our lives"[3].

CHC is a magazine indexed by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and has been distributed to Programa Nacional Biblioteca da Escola (PNBE)/Programa Nacional do Livro e Material Didático (PNLD) since 1991. Ordinance No. 4 of April 1, 2016, shows that CHC was among the journals distributed by MEC until 2018 (Portaria, 2016). In addition, it has been the subject of study by several researchers (Pereira; Terrazan, 2011; Silva *et al*., 2011; Ribeiro; Kawamura, 2011; Baalbaki, 2012; Giering, 2012; Galieta, 2013; Almeida; Giordan, 2014; Baalbaki, 2014; Ramos; Panozzo, 2014; Fraga; Rosa, 2015; Almeida; Lima, 2016; Fukui; Giering, 2016; Baalbaki, 2017; Doretto, 2017; Morais *et al*., 2017; Almeida, 2018; Oliveira; Buehring, 2018; Gomes; Siqueira, 2019; Teixeira *et al.*, 2019; Martins; Florentino de Melo; Oliveira, 2022).

CHC is a science magazine exclusively for children between the ages of 7 and 14. The magazine is not the didactic basis for the teacher's work, but its presence in the school, even in a complementary way, cannot be neglected, since it proposes various strategies for approaching scientific concepts that can be used by teachers, including experimental activities.

According to Schwingel and Giering (2013), the science communication discourse has its origins in science in its broadest sense (biological, exact, human and social sciences) and, in turn, CHC is one of the several ways of disseminating it. For Fraga and Rosa (2015), the term "science communication" describes activities that aim to disseminate scientific

[2] Available in: https://chc.org.br/sobre-a-chc/. Accessed in May 2022.

[3] Available in: https://chc.org.br/sobre-a-chc/. Accessed in May 2022.

knowledge to a non-specialized audience. Thus, when drafting a text of this nature, one must consider the language to be used by the author (Charaudeau, 2008, Silva *et al*., 2011). The author must assume two postures, that of a serious disseminator of scientific concepts, and that of a creative and friendly writer, in order to capture the reader's attention (Schwingel; Giering, 2013).

Science communication texts help to familiarize students with scientific terms and can be a complementary teaching resource to traditionally used materials. Their use can be an important strategy if they are mediated by teachers who provide consistent discussions based on critical readings carried out in the classroom (Rocha, 2012; Souza; Rocha, 2018) so that they do not become obstacles to scientific culture.

Cunha (2009) and Lima and Giordan (2017) emphasize that teachers should avoid directly teaching science communication materials. To this end, there should be a good planning to adapt the materials selected to the teaching situations in order to overcome possible difficulties generated by their use, since the objectives of science communication are different from educational objectives. Nunes and Queirós (2020) reiterate that scientific dissemination must be carried out carefully, which is why teachers must observe the quality of the discursive textual resources before using these materials.

In addition to the playful way in which CHC presents itself, "the magazine's editorial staff states that the texts need to be fun and enjoyable" (Baalbaki, 2014, p. 278) in order to appeal to its intended audience. These characteristics are often met through colorful illustrations, games and activities with which the public can identify itself, and also the presence of mascots. However, it is not uncommon for authors to use anthropomorphic resources in an attempt to capture their audience. Anthropomorphism is a textual resource that attributes human life and characteristics (appearance, feelings, emotions, desires, actions and behavior) to inanimate objects and irrational beings (Andrade, 2006; Kallery; Psillos, 2004). Salcedo de Prado (2009) mentions that, in science communication, anthropomorphism is one of the resources that appears most prominently.

In the next section, we will see that authors who use the Bachelardian framework consider anthropomorphism to be an epistemological obstacle concerning animism. Although there is no consensus on the use of such a resource for the purpose of science communication, its presence suggests attention in its use, at least on the part of researchers and teachers in the science teaching field.

II. Anthropomorphism

Anthropomorphism is understood as the attribution of human characteristics, such as intentions, desires, reasoning and will, to non-human beings, objects or nature phenomena. The "Philosophy Dictionary" (Abbagnano, 2007, p. 68) defines the term as the "tendency to interpret every kind or species of reality in terms of human behavior or by similarity or analogy with such behavior". The anthropomorphic discourse has been explored by writers

and filmmakers in order to reach their children's narratives and is thought to date back to the fables that have been spread around the world (Rocha, 2020). According to Magalhães (2001), anthropomorphization, whether of animals or objects, corresponds to a stage in the children's cognition development.

Due to its attractiveness, anthropomorphism began to be used in didactic or paradidactic materials aimed at this audience in order to increase the reader's interest. However, there is no consensus among scholars dedicated to investigating the topic regarding the implications of using anthropomorphism in scientific discourse.

In the biology teaching field, for example, Zohar and Ginossar (1998) explain that this is an unresolved issue for many educators, and even cite various works to highlight the controversy in the literature. These authors are in favor of breaking the taboo on the anthropomorphism use, considering that its use does not induce any real harm and that this censorship forces the biology educators' community to give up on the didactic potential of such explanations.

Referring strictly to the field of teaching, Zohar and Ginossar (1998) point out that a total rejection of anthropomorphic-based formulations and explanations would be justified if there were a consensus among specialists. However, based on a review of texts in the field, they point out that, among the theorists they consider prominent, there is no such consensus. The authors point to the existence of studies that indicate the importance of formulations with anthropomorphic bases in helping students to organize information from known situations, as well as transforming long formulations into shorter ones. This would increase students' empathy with scientific topics, but on the other hand, such approaches could interfere with the causal scientific explanations' accuracy.

We believe that one factor that should be considered in this discussion is the students' age group. For example, in a study of 28 high school students, Tamir and Zohar (1991) concluded that the acceptance of anthropomorphic formulations does not necessarily imply a prevalence of anthropomorphic reasoning. In the same study, it was found that the majority of students were able to distinguish between anthropomorphic formulations and factual explanations. The authors' studies do not use the Bachelardian framework and consider that teleology can be considered a special case of anthropomorphism, when the explanation is given in terms related to human intentional behavior.

According to Friedler et al. (1993), both age and level of education are factors related to the use of anthropomorphism. The authors based their conclusion on two studies: one with higher education students, which revealed that university students from scientific fields used more rational and less anthropomorphic explanations than students from humanities fields; and the other with secondary school students, from which the authors found that the use of anthropomorphism tended to decrease as the age of the students increased.

The resource of attributing human characteristics to other living and non-living beings is considered an animistic or anthropomorphic obstacle by researchers who use the

Bachelardian reference (Lopes, 1993; Linsingen, 2008; Silva, 2008; Andrade *et al*., 2002; Costa, 2012; Araújo, 2017; Larentis *et al*., 2018; Tripet, 2019), thus considering the two terms synonymous. Andrade et al. (2002, p. 5) cite that "the animist obstacle translates into a tendency to naively animate, attribute life and often anthropomorphic properties to inanimate objects". Costa (2012, p. 8) explains that the animist obstacle takes "material and abstract phenomena and objects into the field of human biology, attributing anthropomorphic properties to them". Lopes (1993), when analyzing chemistry textbooks based on Gaston Bachelard's epistemology, mentions that:

> *The indiscriminate use of scientific terms, without distinguishing their meanings in relation to common language terms, can not only prevent the mastery of scientific knowledge, but also crystallize misconceptions, real obstacles to abstraction. It traps the student in naive realism or conveys an anthropomorphic view of the world.* (LOPES, 1993, p. 317).

Tripet (2019) researches anthropomorphism and its links with French children's literature on astronomy themes. Based on Piagetian theory, the author argues that children up to the age of 7 have difficulty distinguishing between reality and imagination. The research identified various aspects of anthropomorphism, which appear in the illustrations (physical and emotional characteristics of the stars, such as eyes and mouths on the Sun and Moon) and in the oral or written explanations, or only in the illustrations. The author mentions that the students were influenced by representations seen in their daily lives, in literature or on television, which could be related to their age group, but not always, as there are cases of students of the same age presenting different aspects of anthropomorphism, and sometimes some inadequate conceptions are carried into adulthood. The research suggests confronting students' conceptions with scientific explanations so that students can perceive the gap among what they think, the real and the imaginary, but recognizes the challenges of this deconstruction (Bachelard calls it an epistemological rupture) and recommends continuous attention from teachers based on spiral teaching.

Araújo and Rosa (2015) analyze textbook collections from the 2012 PNLD based on empirical studies that identify obstacles to students' understanding of evolutionary concepts. The authors cite that Santos (1991; 1998), considering Bachelard's epistemology and science teaching, establishes the 'tendencies of thinking', among which is "finding a reason for attributing life and anthropomorphic properties to inanimate objects" (Araújo; Rosa, 2015, p. 591).

Larentis *et al.* (2018) cite that Michel Pêcheux (1971, p. 390) argues that the animist obstacle (as referred to by Bachelard) is called vitalism in the Biological Sciences and has, in this area, conceptual representation in the history of the construction of this science and that, in Physics and Chemistry, "animism operates in the realm of images".

Bachelard (1996), when dealing with the animist obstacle in "The Formation of the Scientific Spirit", criticizes the use of images and animations, attributing feelings to inanimate

beings, such as minerals. He begins his discussion of this obstacle with the questions: “How has the hierarchy of knowledge been re-established by putting aside the primitive consideration of this privileged object that is our body?” (Bachelard, 1996, p. 185-186). The epistemologist mentions that there is an attachment to the need to integrate the three realms”[4]: animal, vegetable and mineral, marking them with vital characteristics, “far from directing itself towards the objective study of phenomena, the greatest temptation is – through animist intuitions – to individualize phenomena and accentuate the individual character of substances marked by life” (Bachelard, 1996, p. 206).

Using examples from 18th century science, Bachelard illustrates, with a few quotes from authors, the use of images that are reminiscent of life, for example, automata, “little paper figures that ‘dance’ in an electric field seemed, due to their movement without an obvious mechanical cause, very close to life” (Bachelard, 1996, p. 47). In relation to activities in elementary education, Bachelard says that “the picturesque and images cause disasters of this kind. It is enough for an experiment to be done with a strange apparatus, and above all for it to come under a different name [...] for the pupils to pay attention: they just stop looking at the essential phenomena” (Bachelard, 1996, p. 48-49).

In a subsequent work, “The New Scientific Spirit”, Bachelard (1934) mentions anthropomorphic aspects of classical science when discussing the process of epistemological rupture for the construction of knowledge related to contemporary science, stating that:

> *Many physicists have highlighted this sudden loss of individuality in the elementary object of the new physics. This is particularly the opinion of Langevin and Planck. Marcel Boll underlines the philosophical importance of this in the following terms: 'Just as the anthropomorphic concept of force was eliminated by Einsteinian relativity, so too must the notion of object, of thing, be renounced, at least in a study of the atomic world* (BACHELARD, 1934, p. 124).

Araújo's research (2017) analyzes the issue of epistemological rupture in Gaston Bachelard's thinking in the great historical changes that occurred in the sciences at the end of the 19th century and the beginning of the 20th century. For Araújo (2017), classical physics was an anthropomorphic science, “that is, as a science that had as its reference the human senses from which it was intended to represent the world through investigations. For both Planck and for Bachelard, the evolution of physical science took place in the detachment of the anthropomorphic and sensualist character.” Araújo (2017, p. 13).

Regarding elementary school students in the early years, there has been little research investigating the impact of anthropomorphic discourse on the construction of scientific

[4] In the 1970s, microbiologist Carl Woese revolutionized biology by redefining the so-called tree of life by classifying it into three domains - Bacteria, Archaea and Eukarya - based on fundamental molecular and structural differences. The same researcher demonstrated that prokaryotes are divided into two distinct lineages: Archaea and Bacteria. Today, these groups are considered to form two of the three domains of life. The third domain (Eukarya) includes all eukaryotes, such as plants, animals and fungi.

concepts. Authors who argue against the use of anthropomorphic explanations in science teaching, such as Andrade (2006), consider that such action does not contribute to the construction of scientific concepts and can lead to mistaken or incomplete knowledge.

This discussion in the teaching area generally focuses on the biology teaching field, where the use of anthropomorphism and teleological discourse in the concepts construction in the area is generally investigated. Hartelt, Martens and Minkley (2022) point out that discussions in the biology field have more potential for anthropomorphic representations, since it is common to attribute human characteristics to living organisms. Talanque (2013) points out that there are few studies on the use of anthropomorphism in other areas of the Natural Sciences, such as in the Physics and Chemistry teaching, which we consider to be a gap in the area, nor are there any studies with children. In this context, the aim of this work is to recognize anthropomorphic aspects in the illustrations of experimental activities of the magazine Ciência Hoje das Crianças, in the 2009-2020 editions, which may pose obstacles to the construction of scientific knowledge.

III. Analysis organization

The corpus of this research consists of 196 experimental activities published by the CHC journal in the 2009-2020 editions. The methodological approach chosen to analyze them is characterized as qualitative and documental.

To analyze the material, we used the triple-blind strategy, seeking to identify anthropomorphic aspects present in the illustrations of the CHC experimental activities (2009-2020 editions). We call an illustration each scenario/scene that appears in the activities. In the first stage, the analysis parameters were established (described later). In the second, the experimental activities illustrations were analyzed individually by the authors. In the third stage, the individual analyses were compared and differences resolved.

The analyses were carried out based on the following parameters.

1. Physical characteristics: refer to aspects related to clothing or body structure that represent irrational beings and/or inanimate objects. This category was divided into:

a) ornaments - refer to clothes, shoes and make-up;

b) human features - refer to physical appearance, e.g. legs, arms and face with human-like eyes, mouth, nose.

2. Behaviors: refer to characteristics related to human-like bodily or gestural expressions in irrational beings and/or inanimate objects, such as feelings and actions.

After identification, the illustrations and anthropomorphic representations in these activities were counted. The following section describes how the representations and illustrations in the CHC experimental activities were quantified.

IV. Anthropomorphic aspects counting

We noticed that the CHC magazine can present several anthropomorphic characteristics related to physical and/or behavioral aspects in the same experimental activity. Therefore, in this research, characterization was counted only once for each activity, as described in the following one.

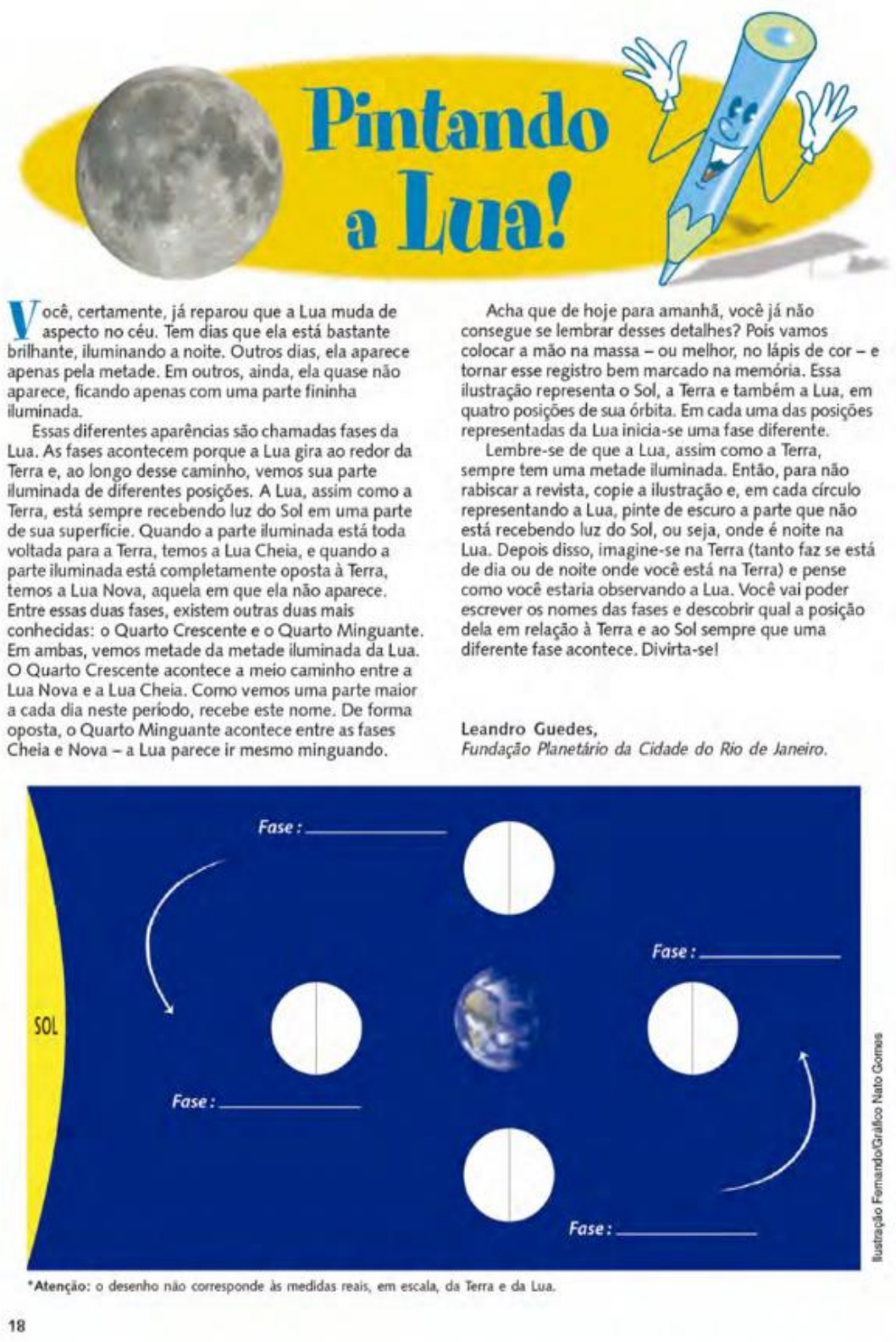
In the experimental activity in Figure 1, the pencil representation shows physical and behavioral characteristics, so it was classified into two categories of analysis. The first identified human features, such as: arms, hands, eyes, mouth, teeth and nose, and the second category recognized the smile, classifying it as a human emotional behavior. Although the pencil is represented with various human physical features (arms, eyes, nose and mouth), these were counted only once in the "physical features" category. In the same activity, more than one illustration can be identified, for example, in this activity, two scenarios appear, accounting for two illustrations.

IV. Results

A total of 434 illustrations in 196 experimental activities from the CHC magazine were analyzed, and two criteria to identify them by curricular component/area were used: i) self-titled and ii) concepts or expressions specific to the areas. We consider self-titling when the text of the experimental activity makes explicit the area of knowledge to which it refers. When the area is not explicit, we resorted to analyzing the approach chosen by the activity and identifying specific concepts or expressions that appear in the text. These criteria allowed us to identify activities dealing with topics related to: Mathematics, Physics, Chemistry, Biology, Astronomy, Physical Education, Portuguese and Geography.

We have identified as Biology activities proposals that include concepts related, for example, to recycling, living beings and DNA. In Chemistry, acids and bases, reactions. In Physical Education, body movement activities. In Portuguese, proposals that encourage writing (building magazines, word games, etc.). In Mathematics, there are proposals covering fundamental operations and geometric shapes. Astronomy activities include concepts related to stars and celestial phenomena. Geography activities cover map-making and recreation. In Physics, activities with magnets, electrification processes, heat propagation and energy.

It is worth emphasizing that the separation was not rigid and exclusionary, so that the same activity can integrate subjects from different curricular components/areas. Thus, although 196 experimental activities from the CHC magazine were analyzed, the overall total in Table 1, which relates the number of activities per curricular component/area to the number of anthropomorphic aspects identified, is 228 proposals.



Pintando a Lua!

Você, certamente, já reparou que a Lua muda de aspecto no céu. Tem dias que ela está bastante brilhante, iluminando a noite. Outros dias, ela aparece apenas pela metade. Em outros, ainda, ela quase não aparece, ficando apenas com uma parte fininha iluminada.

Essas diferentes aparências são chamadas fases da Lua. As fases acontecem porque a Lua gira ao redor da Terra e, ao longo desse caminho, vemos sua parte iluminada de diferentes posições. A Lua, assim como a Terra, está sempre recebendo luz do Sol em uma parte de sua superfície. Quando a parte iluminada está toda voltada para a Terra, temos a Lua Cheia, e quando a parte iluminada está completamente oposta à Terra, temos a Lua Nova, aquela em que ela não aparece. Entre essas duas fases, existem outras duas mais conhecidas: o Quarto Crescente e o Quarto Minguante. Em ambas, vemos metade da metade iluminada da Lua. O Quarto Crescente acontece a meio caminho entre a Lua Nova e a Lua Cheia. Como vemos uma parte maior a cada dia neste período, recebe este nome. De forma oposta, o Quarto Minguante acontece entre as fases Cheia e Nova – a Lua parece ir mesmo minguando.

Acha que de hoje para amanhã, você já não consegue se lembrar desses detalhes? Pois vamos colocar a mão na massa – ou melhor, no lápis de cor – e tornar esse registro bem marcado na memória. Essa ilustração representa o Sol, a Terra e também a Lua, em quatro posições de sua órbita. Em cada uma das posições representadas da Lua inicia-se uma fase diferente.

Lembre-se de que a Lua, assim como a Terra, sempre tem uma metade iluminada. Então, para não rabiscar a revista, copie a ilustração e, em cada círculo representando a Lua, pinte de escuro a parte que não está recebendo luz do Sol, ou seja, onde é noite na Lua. Depois disso, imagine-se na Terra (tanto faz se está de dia ou de noite onde você está na Terra) e pense como você estaria observando a Lua. Você vai poder escrever os nomes das fases e descobrir qual a posição dela em relação à Terra e ao Sol sempre que uma diferente fase acontece. Divirta-se!

Leandro Guedes,
Fundação Planetário da Cidade do Rio de Janeiro.

Fase : _____

Fase : _____

SOL

Fase : _____

Fase : _____

Ilustração Fernando/Gráfico Nato Gomes

*Atenção: o desenho não corresponde às medidas reais, em escala, da Terra e da Lua.

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Fig. 1 - Example of counting the anthropomorphic aspects in the experimental activities CHC figures (2009, ed. 203, p. 18).

Table 1. Anthropomorphic aspects by curricular component/area at CHC (2009-2020).

Curricular component/area	Activities number by curricular component/area	Activities featuring anthropomorphic aspects
Biology	74	20 (27%)
Physics	67	22 (33%)
Physical Education	19	2 (11%)
Chemistry	47	18 (18%)
Mathematics	11	2 (20%)
Astronomy	4	2 (50%)
Portuguese	4	1 (25%)
Geography	2	1 (50%)
Total	228	

Source. The authors.

Table 1 shows that the experimental activities in the CHC magazine deal with various subjects in the natural and human sciences, and that the subjects in the natural sciences (physics, biology and chemistry) are the most frequently covered. Biology (74) and Physics (67) have the highest number of activities, followed by Chemistry (47), Physical Education (19) and Mathematics (11). The smallest number of activities proposed were in Portuguese, Astronomy (4) and Geography (2). It can also be seen that the presence of anthropomorphic aspects did not favor any of the areas of knowledge, the distribution of this characteristic was balanced (similar)[5] among the areas.

Of the 196 activities, 134 have no anthropomorphic aspects and 63 do. Table 2 shows the number of anthropomorphic aspects identified in the illustrations of the CHC experimental activities.

Table 2. Anthropomorphism in experimental activities (2009 a 2020).

Categories	Subcategories	Quantity
Physical characteristics	Ornaments	30
	Human features	78
Behavior		77
Total		185

Source. The authors.

As can be seen in Table 2, the 63 experimental activities in the CHC magazine present 185 anthropomorphic aspects related to physical characteristics and human behavior.

[5] The Chi-square test was used to assess whether there was a likelihood of observing a significant difference between the areas; the result showed that the p-value was not significant.

In this respect, the separation was not exclusive either, as the same activity can present two or more anthropomorphic aspects and thus be part of more than one category of analysis, so the overall total is 185 representations.

Below figures are shown, each with four activities that exemplify anthropomorphic aspects identified in the illustrations of CHC experimental activities. The experimental activities shown in Figure 2 exemplify anthropomorphic aspects of the “physical characteristics: ornaments" category.

In the four activities in Figure 2, selected as examples, we can identify characteristics related to ornaments, such as a dog wearing sunglasses in the "Amazing experiment" and the same animal holding a spoon in the "Tasty multiplication" activity, a penguin wearing a scarf and cap in the "Freezing salt" proposal and a bear wearing a hat in the "How the polar bear protects itself from the cold" activity. All the activities deal with phenomena related to the Natural Sciences, such as the Earth's movements around the Sun and the seasons (winter and summer solstices; and equinoxes); the process of fermenting milk to produce yogurt; the study of the melting temperature of a substance; and the role of adipose tissue in maintaining body temperature”.

The experimental activities shown in Figure 3 exemplify anthropomorphic aspects that represent the “physical characteristics: human features” category.

In the four examples shown in Figure 3, inanimate beings have some human features, such as eyes, mouth, arms, hands, legs and feet. The phenomena dealt with in these activities are related to the Natural Sciences, and are: surface tension (“Superpowered soap!”); light refraction (“Light deflection”); chemical reactions (“Soft bone”); and shadows (“Light, colors and fun”).

The experimental activities shown in Figure 4 exemplify anthropomorphic aspects related to the “behavior” category.

In the four examples shown in Figure 4, the animals are represented with some human behavior, such as the chicken's irritation in an art activity (“Broken egg”); the bacteria's smile when dealing with microbiological culture media (“Pet bacteria”); the polite behavior of the cat yawning and covering its mouth when it came to a chemical reaction (“Chemical pillow”); and a dog with one of its paws on its waist and the other resting on the table, in an activity related to Geography, when building maps (“Paper map”).

Figure 5 shows the three mascots of CHC magazine: the bee Zíper and the dinosaurs Rex and Diná. These characters always have anthropomorphic characteristics. Because they appear numerous times in the magazine, presenting sections, carrying out experiments and talking about the environment, among other activities, as well as presenting characteristics of the three categories, we chose to treat them separately.

Fig. 2 – Experimental activities in the "physical characteristics: ornaments" category CHC (2012, ed. 235, p.18; 2013, ed. 238, p.19; 2016, ed. 282, p. 17; 2020, ed. 312, p. 17).

Fig. 3 – Experimental activities in the "physical characteristics: human features" category CHC (2010, ed. 216, p. 20; 2014, ed. 260, p. 18; 2015, ed. 266, p. 12; 2015, ed. 271, p. 26).

Fig. 4 - Experimental activities representing the "behavior" category CHC (2011, ed. 221, p. 17; 2012, ed. 231, p.19; 2013, ed. 242, p. 19; 2014, ed. 263, p. 17).

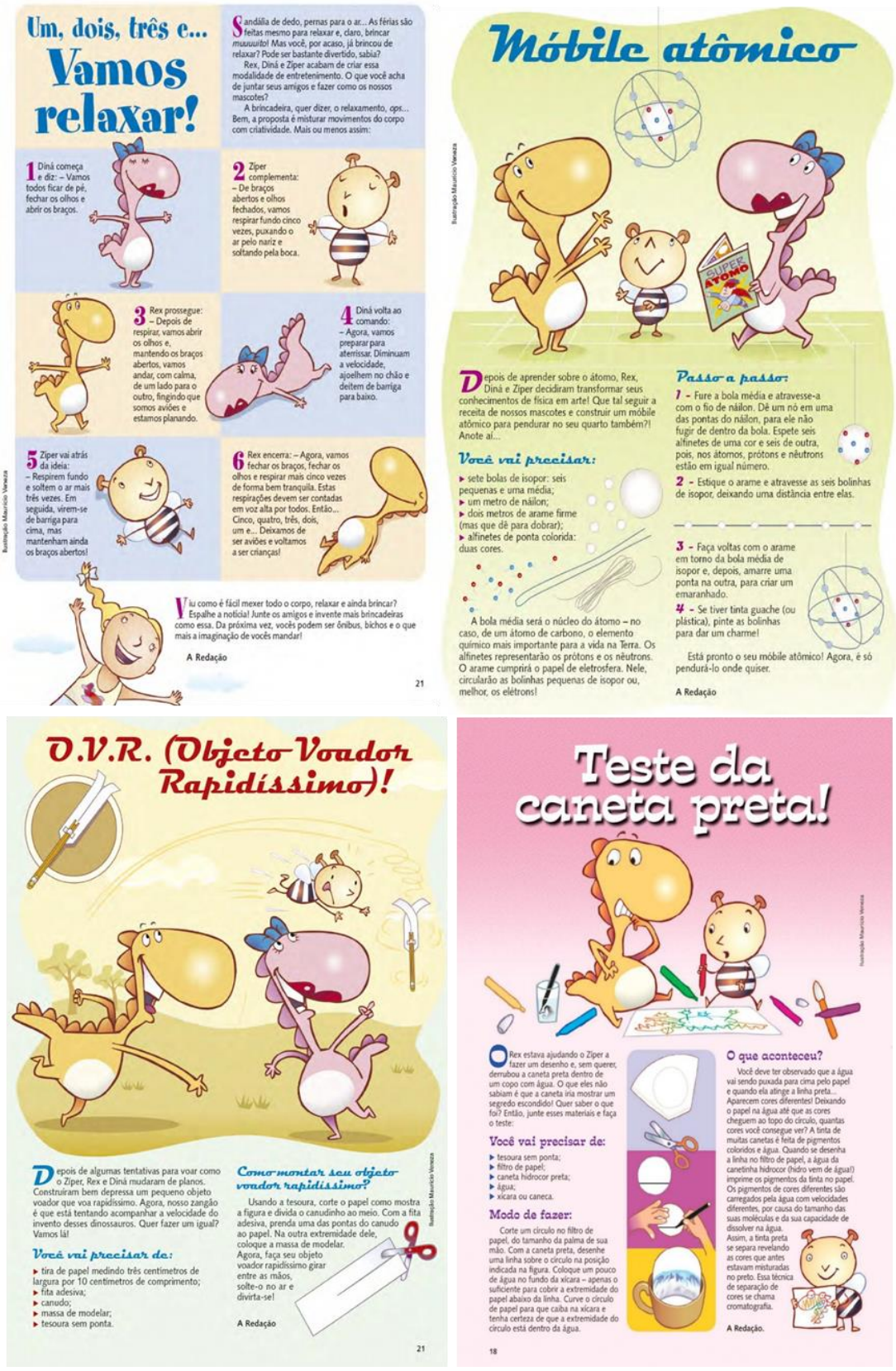

Fig. 5 – Experimental activities featuring the magazine's mascots CHC (2010, ed. 209, p. 21; 2011, ed. 223, p. 19; 2011, ed. 227, p. 21; 2013, ed. 247, p. 18).

These characters were not present in the first issues of the magazine and were added later. Initially Rex, in the first independent issue of the magazine, and soon afterwards the other characters appeared because, according to CHC, readers found Rex too lonely. Like Rex, Diná and Zíper were created by illustrator Ivam Zigg: Rex, in issue no. 16 of 1990; Diná, in issue no. 24 of 1991; and Zíper, in issue no. 30 of 1993 (Silveira, 2010).

Although mascots appear in various sections of the CHC magazine, Figure 5 shows their presence in the experimental activities. Of the experimental activities analyzed (196), 63 had anthropomorphic aspects; of these, mascots appeared in 19 activities.

Looking at the activities in Figure 5, it's possible to identify that the three mascots have human physical characteristics, such as arms, hands, legs, feet and faces (eyes, nose, mouth and teeth). Diná always presents herself with props, such as lipstick and a ribbon in her hair, and, on several occasions, the mascots present themselves with human behavior: in the first activity, they are relaxing; in the second and third, they are paying attention to the atomic mobile and the flying object; and, in the fourth activity, they present a worried facial expression.

IV. Results Discussion

We identified 63 experimental activities proposed by the CHC that feature illustrations with anthropomorphic aspects related mainly to human features and behavior in their illustrations, were identified. These illustrations have great appeal for children, which is why they were chosen as the object of analysis in this work. Furthermore, the CHC magazine always presents them in full color and almost half the size of the page, making it possible to draw students' attention to this motivational and attractive element.

Bachelard (1996) mentions that the science teacher has a key role to play in overcoming the epistemological obstacles that can arise when carrying out experimental activities, preventing their function from being merely motivational and enabling students to develop rationalization. The author draws attention to the problems that illustrations can cause when used in elementary school activities, where the picturesque draws more attention than the essential phenomena. The author warns that illustrations should not be false centers of interest, obstacles to the scientific spirit formation.

Regarding the aspects related to anthropomorphism, of attributing life and human characteristics to inanimate objects and irrational beings, as already mentioned, they are considered animic obstacles by researchers who consider the Bachelardian framework. Bachelard (1996), when looking at the 18th century science, already criticized the use of illustrations that attribute feelings to inanimate beings, privileging human characteristics to give them aspects very close to life, as appears in the CHC experimental activities.

In this regard, there is concern about the necessary mediation that will have to be exercised by teachers using CHC activities or other materials that may also have this characteristic. The use of attractive resources, especially for children, is extremely desirable.

However, when it comes to building scientific concepts, a process in which misconceptions often remain for years, all caution is welcome.

IV. Final considerations

The aim of this study was to analyze the presence of anthropomorphic features in illustrations of CHC experimental activities in the 2009 to 2020 editions. As a result, we found that 63 activities out of a total of 196, featured these characteristics in the illustrations. There was a total of 185 anthropomorphic representations, of which 78 were related to “physical characteristics: human features”, 77 to “behavior”, and 30 to “physical characteristics: ornaments”.

In the “physical characteristics: human features” category, features such as the face, legs, arms and eyes were identified in representations of objects, animals and celestial bodies. In the “behavior” category, the experimental activities feature objects, microorganisms and animals with body expressions or gestures similar to humans, such as cooking, painting, smiling, among others. In the “physical characteristics: ornaments" category, animals and celestial bodies were recognized using clothes, glasses, hats, shoes and make-up.

Our results show that the magazine does not rely mainly on this resource to attract and captivate its readers in the illustrations of the experimental activities. This is because, in more than two thirds of these activities, no anthropomorphic features were found, although the magazine's mascots are represented with these features, both in terms of physical characteristics: human features and ornaments, as well as in terms of behavior.

With regard to the implications of this research for science teaching, even though there is no consensus on the use of representations with anthropomorphic features impact on the scientific concepts construction, either by children or adolescents, we believe that it is important to highlight their presence in materials present in schools, even if they are not used as teaching materials. The CHC magazine reaches schools through public funding, so it is crucial that the field of science teaching research in Brazil looks at the material to generate results that help teachers use it efficiently, as a material that helps students build scientific concepts. Furthermore, according to Zimmermann and Bertani (2003, p. 46), considering Bachelard's thoughts on teacher training, “teaching activity can and should be developed through the constant problematizations faced in the classroom and, therefore, through conscious and constant reflection”.

As a prospect for future research, we believe it is important to carry out investigations with students who want to reflect on the limits and possibilities of this visual resource for the scientific concepts construction, as well as the investigation of anthropomorphic features in proposals for experimental activities of other contents and in the other sections of the magazine.

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