

Graphic representations of vaccines in natural sciences textbooks for high school

ABSTRACT

The images of vaccines in textbooks stimulate different ideas about the theme health which can be used for pedagogical purposes in basic education. Therefore, the goal of this research is to characterize the graphic representations of vaccines in natural sciences textbooks for high school. The methodology is qualitative in approach, and its typology is documentary. The material which was chosen for the documentary analysis is a collection of six textbooks of natural sciences and their technologies for high school and it is distributed by the Programa Nacional do Livro e do Material Didático of the year 2021. As results, nine graphic representations of vaccines were identified, which are classified as illustrations, visual diagrams and quantitative representations. There is a predominance of representations classified as illustrations, such as photographs and drawings. We highlight the importance of variety of vaccine representations for educational purposes in natural sciences textbooks. As possible future research, there is the analysis of vaccine images in textbooks of different segments in basic education.

KEYWORDS: Images; Biology teaching; Textbooks; High school; Health education.

Representações gráficas de vacinas em livros didáticos de ciências da natureza do ensino médio

RESUMO

As imagens de vacinas presentes em livros didáticos suscitam diferentes ideias sobre o tema saúde que podem ser utilizadas para fins pedagógicos na educação básica. Nesse sentido, o objetivo geral é caracterizar as representações gráficas sobre vacinas presentes em livros didáticos de ciências da natureza para o ensino médio. A metodologia de pesquisa utilizada é de abordagem qualitativa, com tipologia documental. O material escolhido para a realização da análise documental, por meio do referencial da análise de conteúdo, é uma coleção de seis livros didáticos de ciências da natureza e suas tecnologias para o ensino médio, distribuída pelo Programa Nacional do Livro e do Material Didático, no ano de 2021. Foram identificadas nove representações gráficas de vacinas como resultados, classificadas como ilustrações, diagramas visuais e representações quantitativas. Destaca-se a predominância de representações do tipo ilustrações, como as fotografias e os desenhos. Finalmente, ressaltamos a importância da presença de uma variedade maior de imagens de vacinas e que tenham finalidade pedagógica em livros didáticos de ciências da natureza. Como possibilidades para futuras pesquisas, estão as análises de imagens de vacinas em livros didáticos de diferentes segmentos da educação básica.

PALAVRAS-CHAVE: Imagens; Ensino de biologia; Livro didático; Ensino médio; Educação em saúde.

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INTRODUCTION

Languages like graphics, photographs and diagrams have been attracting attention because of their presence in different social contexts. At school, they are gaining more focus due to the presence of those images on the visual composition of textbooks and their articulation with other types of languages, such as words and numbers (Alves, Yamashita & Francisco-Junior, 2023). Within the contents of natural sciences at school, they can ease the interpretation of information and contribute to the construction of knowledge at school. In textbooks, that type of resource aids to develop perception, attention and memory while learning (Lemos, 2018; Rudek & Hermel, 2022).

The role of images in the elaboration of contents for textbooks has been expanded, which means that “images are used to communicate with readers, aiding on knowledge acquisition and being intentional to attract the attention of readers” (Rudek & Hermel, 2022, p. 264). Considering the textbook as part of the culture of schools and its importance to create knowledge, it is necessary to comprehend the way that images and texts are used (Vogt, Cecatto & Cunha, 2018). The images are used to visually represent the environment or a phenomenon and can be found in different forms, such as engravings, drawings, paintings, photographs and other types of representations (Lima, Oliveira & Rosa, 2018).

Textbooks depend on the continuous work of authors and editors to answer the demands of the curriculum, the education legislation and the market. The *Programa Nacional do Livro e do Material Didático* (PNLD) was reformulated to answer to the requirements of the document named *Base Nacional Comum Curricular* (BNCC) and the reform of high school, which changes the logic of production, organization, selection and presentation of the book’s contents. Sometimes, the textbook is the only available resource at schools because of its free distribution. However, it is possible to find conceptual problems within them. Thus, it is important to critically evaluate those resources in regards of wrong or distorted information (Castro, 2015; Lima, Oliveira & Rosa, 2018; Amaro, Azevedo & Borba, 2023; Conceição & Lorenzetti, 2023; Martins & Venturi, 2023).

Images of vaccines in textbooks of natural sciences for high school are examples of resources that can be used in health thematic classes. In the school curriculum, the theme is predicted as the planning of a set of classes that address health topics. Even though it was initially attached to standardized concepts, that theme has been perceived as a way stimulate the development of people’s knowledge and autonomy in relation to individual and collective aspects of health (Venturi & Mohr, 2021; Rudek & Hermel, 2022).

In high school, images like maps, tables and diagrams related to natural phenomena are the most common (Kress & Leeuwen, 2021; Alves, Yamashita & Francisco-Junior, 2023). The way that vaccines are visually presented in textbooks can influence the perception of students about the importance of that product for society. In that context, the following question was elaborated: how images of vaccines are represented in textbooks of natural sciences and their technologies for high school? In that sense, the goal of this research is to characterize graphic representations of vaccines in textbooks of natural sciences for high school.

METHODOLOGY

This research is a piece of a master's dissertation. The qualitative approach was adopted. Qualitative research is characterized by intense contact with the phenomenon studied and consequently, the gathering of descriptive data, which can be descriptions of people, situations and events through interviews, testimonials, photographs, drawings and other documents. The focus is the process instead of the product. Thus, the way that a problem is manifested in activities, procedures and daily interactions, the meaning given by people to those different aspects and the analysis of data through an inductive process are the focus of this type of research (Ludke & André, 2018).

A possible way to conduct qualitative research by using visual resources to compose the *corpus*. The image is an important form of visual information record, and it is widely used because of the means of communication. Therefore, it influences social, politic and economic aspects of life through medias. However, images are not free from manipulation. They are simplified representations of a complex reality, and they are in constant transformation. Some examples of images that can be integrated into the *corpus* of research are photographs, painting and video, which is a sequence of images with sound. Among some usages of that type of resource in research, there are documentations of historic changes, cultural analysis of an era and investigations on gender relations (Bauer & Gaskell, 2002).

The technique of documental analysis is an important tool in approaches that aim the generalization of qualitative data. Documents that can be used for that type of analysis must contain recorded information, such as school resources, letters, diaries, norms, newspapers, magazines and movies. Those documents are natural sources of information because they are part of a historic moment and are records of aspects of the way of thinking and acting in the context of an era. Thus, it is important that those resources are selected and analyzed with time and attention to identify relevant data for the research (Ludke & André, 2018).

The chosen resources for documental analysis are textbooks that integrate the collection named *Multiversos Ciências da Natureza*, by Leandro Godoy, Rosana Maria Dell'Agnolo and Wolney C. Melo. The criterion used to choose that collection is to be part of the PNLD from 2021. In the following table, there are the textbooks of the analyzed collection:

Table 1

Textbooks of the analyzed collection.

Volume	Title
1	Multiversos Ciências da Natureza: matéria, energia e vida
2	Multiversos Ciências da Natureza: movimentos e equilíbrios na natureza
3	Multiversos Ciências da Natureza: ciência, sociedade e ambiente
4	Multiversos Ciências da Natureza: origens
5	Multiversos Ciências da Natureza: eletricidade na sociedade e na vida
6	Multiversos Ciências da Natureza: ciência, tecnologia e cidadania

Source: Godoy, Dell’Agnolo & Melo (2020a, 2020b, 2020c, 2020d, 2020e, 2020f).

The PNLD is constituted by the evaluation, acquisition and free distribution of didactic and literary resources to regular schools of basic education or to the *Educação de Jovens e Adultos* (EJA) from municipal, state and federal levels of education. The organization of the PNLD is a responsibility of the *Ministério da Educação* (MEC) alongside the *Fundo Nacional de Desenvolvimento da Educação* (FNDE). The resources are constituted by six technical documents related to the context of basic education. According to the data of the *Sistema do Material Didático* (SIMAD), it appears that 97 of 104 schools from the city of São Luís of Maranhão adopted that collection for the subject named natural sciences since 2022, considering the validity of four years of the collections distributed by the PNLD in 2021.

The analysis of qualitative data is part of a process of systematization of data that is coherent with the focus of the research (Ludke & André, 2018). The content analysis method was used in the analytical treatment step. It is a rigorous and flexible methodology to make new discoveries, and its purpose is to surpass the uncertainties of messages through the enrichment of the text by describing the meaningful elements hidden between the lines (Bardin, 2016).

Furthermore, the set of images of vaccines in textbooks was chosen as the object of analysis. The choice depends on the goal of the research and the availability of resources. Generally, images are accompanied by texts, which are important to comprehend the meaning of that type of resource and must be included in the analysis. Another important aspect of the analysis of images is the description of the visual composition of the resource. That process used in the *corpus* of research is known as semiotic analysis of static images and its purpose is to turn explicit its cultural meanings (Bauer & Gaskell, 2002).

The process of categorization consists of two steps: the elaboration of an inventory and the process of classification to organize it. The purpose of elaborating categories is to systematize the data through techniques of condensation. The rules that conduct that process are mutual exclusion, which consists in the condition of exclusivity of a unit to only one category. The pertinence, which depends on theoretical basis well defined and that can be adapted to the chosen material for analysis. Objectivity and loyalty, which establish a standardization for

the process of data codifying. Finally, the productivity, which is expressed as indexes, inferences, new hypotheses and exact data (Bardin, 2016).

After the process of identification of vaccine images, considering the criteria of inclusion and exclusion, only volumes 2 and 6 were selected from the collection named *Multiversos Ciências da Natureza*. The images in those textbooks refer to contents of Sexually Transmitted Infections (STI), genetics and biotechnology. The textbooks that were included can be found codified and organized in the following table:

Table 2

Codification of the selected textbooks for the analysis of images.

Code	Title
L1	Multiversos Ciências da Natureza: movimentos e equilíbrios na natureza
L2	Multiversos Ciências da Natureza: ciência, tecnologia e cidadania

Source: Godoy, Dell’Agnolo & Melo (2020b, 2020f).

In the following table, there are the types of graphic representations used as reference for the categories of analysis. The analysis was based on types of graphic representations in textbooks of biology, by López-Manjón and Postigo (2014), as it can be seen below:

Table 3

Description of graphic representations categories.

Category	Description
Illustration	It represents external aspects of a phenomenon and aims to visually present the information of texts. For example, photographs, and drawings.
Visual diagram	It represents physical characteristics of an object from different angles, such as representations of the human body systems accompanied by subtitles that indicate their structures. They can present the chronology of a phenomenon by using graphisms like arrows, segments and color changes.
Verbal diagram	It consists of spatial organization of words and represents relations between different concepts through schemes with graphic elements, such as arrows. For example, mind maps and concept maps.
Quantitative representation	It represents numeric relations between two or more variables through the usage of elements, such as lines, bars and arrows. For example, data tables and numeric graphics.

Source: Adapted from López-Manjón & Postigo (2014).

Results and discussions from that analytic process on graphic representations of vaccines in textbooks of natural sciences are in the following section.

RESULTS AND DISCUSSIONS

After analysis, 9 graphic representations were identified in the textbooks. They are photographs of vaccines, drawings of vaccination campaigns, tables with vaccination coverage rates and a visual diagram about the effects of vaccination in the human body.

In L1, only 1 graphic representation classified as an illustration was identified as a drawing. It is part of the unit named “Balanced health”, in the topic about pregnancy, contraception and prevention of sexually transmitted infections (STI).

In L2, a total of 8 graphic representations were identified. They are part of the unit named “Genetics and technology”, in the topic about biotechnology and the topic about vaccines and serums. The specific types of graphic representations were: 6 illustrations, of which 4 are photographs and 2 are drawings; 1 quantitative representation; and 1 visual diagram. One of the results was identified without a descriptive subtitle. There are no results identified as verbal diagrams.

Another important result is the variety of vaccines graphically represented in L1 and L2. The vaccines present in the collection of textbooks are to prevent hepatitis B, polio, HPV, meningitis and genetic vaccines against AIDS, which appear as vaccines in development in these resources. The results obtained were used to discuss the data with the available literature. They can be found after a brief context about research on image analysis.

Before visual compositions became important in the context of science teaching, images were researched in arts, media and people’s lives, referred to by the term “visual culture” in an interdisciplinary field of research about the cultural elaboration of different types of images. They investigated the forms of visual organization in social contexts and in power dynamics (Amaral, Camel & Guerra, 2025). Their references were the history of art, the aesthetic description of visual compositions and psychological aspects of visual productions, such as advertisements and packages of commercial products (Kress & Leeuwen, 2021).

The usage of that term to refer to images in social media has been resignified according to the local and historic realities. It was used until the decade of the 1990s on television programs and advertisements. Posteriorly, the term was adopted to refer to images on digital media due to the usage of computer programs and the implementation of internet networks (Barbosa, 2017). With the introduction of semiology studies and semiotic techniques, systematic studies about the patterns and the grammar of images started to appear. Images are manifestations of the interpretation of individual experiences, and their meanings are historically and culturally built. The interpretation of visual compositions is based on the disposition of lines, colors, shading and plan perspectives (Kress & Leeuwen, 2021).

In Brazil, the first reference on image usages at school is Ana Mae Barbosa and her triangular approach to art teaching, which consists of articulations between cognitive, analytical and creative process to develop the skill of critic analysis of images, objects and the visual reality (Barbosa, 2017). That approach highlights the importance of interpretation of images through a creative process of recodification and attribution of meanings, transforming readers into recreators of the author of a visual composition (Barbosa, 2022). Foreign authors like Gunther Kress and Theo Van Leeuwen talk about images analysis as a process that consists in the development of analytical skills on visual representations in cultures (Kress & Leeuwen, 2021).

In the context of natural science teaching, the diversity of languages, such as images, became more important in textbooks. In figures 1, 2, 3 and 4, classified as illustrations, photographs of vaccines can be observed:

Figure 1

Photograph of a vaccine vial to prevent hepatitis B.

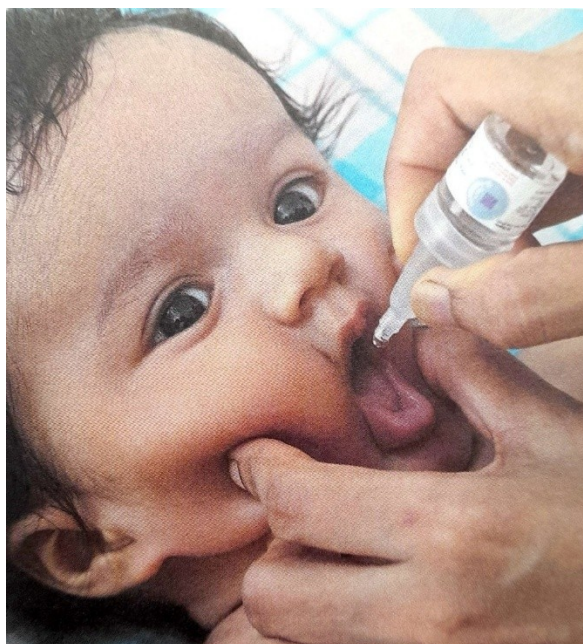


Source: Godoy, Dell’Agnolo & Melo (2020f).

Figure 1 presents a photograph of a vaccine vial to prevent hepatitis B held by someone’s fingers. The image is in L2 and its subtitle is: “Vaccine against hepatitis B, produced through the recombinant DNA technique” (Godoy, Dell’Agnolo & Melo, 2020f, p. 65).

Figure 2

Photograph of a child being vaccinated.

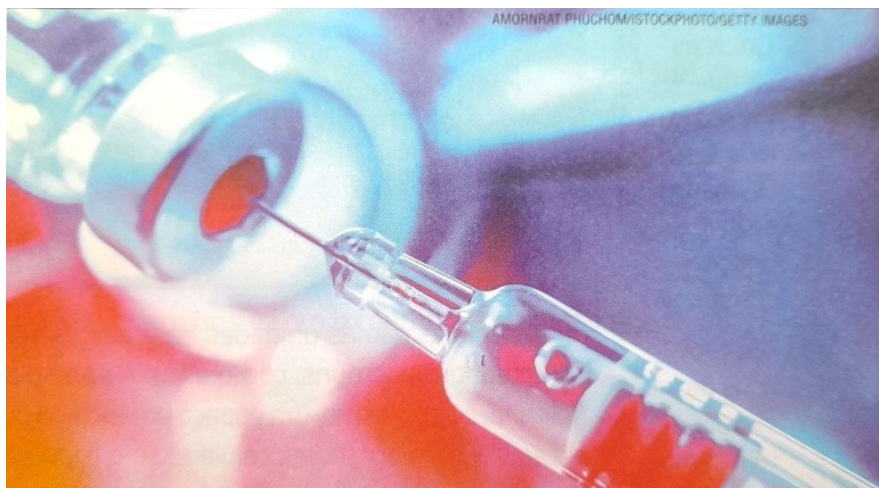


Source: Godoy, Dell’Agnolo & Melo (2020f).

Figure 2 presents a photograph of a child receiving a drop of polio vaccine through the mouth. It can be found in L2 with the following subtitle: “Oral vaccine against polio” (Godoy, Dell’Agnolo & Melo, 2020f, p. 75).

Figure 3

Photograph of a syringe that can be used to apply vaccines, serums and drugs.



Source: Godoy, Dell’Agnolo & Melo (2020f).

Figure 3 presents a photograph of a syringe being used to prepare an injection of the product inside of a vial, which appears to be a vaccine. It is in L2 and presents the following subtitle: “Applications of biotechnology in society involves different sectors, such as health, agriculture, livestock and pharmaceutical, cosmetic, textile, food industries, among others” (Godoy, Dell’Agnolo & Melo, 2020f, p. 44-45).

Although the subtitle does not provide an explicit reference to vaccines, the text that composes the pages in which the photograph was identified says “one of the greatest expectative during the pandemics of SARS-CoV-s (covid-19) was the development of a vaccine” (Godoy, Dell’Agnolo & Melo, 2020f, p. 44) and presents the following questions: “Vaccines are related to immunity. What is immunity? How vaccines work?” (Godoy, Dell’Agnolo & Melo, 2020f, p. 44).

Figure 4

Photograph of a black woman scientist developing genic vaccines against AIDS.



Source: Godoy, Dell’Agnolo & Melo (2020f).

Figure 4 presents a photograph of a scientist woman working at a place that seems to be a science laboratory. It is in L2 and presents the following subtitle: “Scientist woman developing genic vaccines against AIDS” (Godoy, Dell’Agnolo & Melo, 2020f, p. 80).

Photographs present in didactic resources interact with the text in a process of resignification of contents by the students. It presents information of texts in a visual way. For example, in figure 1, the text in the composition of the page says: “The vaccine against hepatitis B is an example of product obtained through the recombinant DNA technique” (Godoy, Dell’Agnolo & Melo, 2020f, p. 65). The textbook’s image and text must be articulated to aid the interpretation of contents.

It becomes even more important in science contents that are more abstract or distant from the students' reality (Vogt, Cecatto & Cunha, 2018).

The photograph makes the content described in words less abstract. Due to the presence of photographs in natural sciences textbooks, it is important to talk about possible ways to manipulate them. The supposed reality of photographs is based on available technologies to record images and other resources. For example, it is possible to manipulate a photograph by using resources like software. Thus, photographs are considered as representations of a reality set by cultural conventions created throughout history (Pralon, 2019).

It is important to think about didactic criterion to use photographs in textbooks to surpass their decorative aspect because it reduces their function into illustrations of the text. Students may face difficulties interpreting photographs because they are not self-explanatory and they usually are ambiguous. Photographs evoke a mediatorial function of teachers on image interpretation and enable students to create their own meanings. There is no problem in having illustrative photographs in textbooks, but some of them should be used in pedagogic practices (Alves, Yamashita & Francisco-Junior, 2023).

An example of usage of scientific content in photographs is from the scientist Vital Brazil, the first director of *Butantan* Institute in the field of vaccines and serums production. Among his activities, there were antivenom campaign and educative actions to prevent accidents cause by snakes. He used scientific photographs and engravings on his campaigns for educative purposes. Therefore, imagery productions associated with texts were used as guides to catch and to identify snakes. Furthermore, photographs were also used to demonstrate processes of extraction, correct handling of those animals, application of serum, and infrastructure conditions of the place where those actions happened (Fernandes & Chaves, 2015).

Something similar can be seen in figure 4, in which a black woman scientist is producing vaccines. However, it is noted that it only presents a moment of her work as an illustration. Photographs used in textbooks must characterize the theme being studied through the representation of steps of scientific processes. In other words, it is important to value the process instead of representing just the final step. Therefore, textbooks should present sequences of photographs to represent the phenomena being studied (Vogt, Cecatto & Cunha, 2018).

Another aspect to be highlighted for the usage of photograph is the intentionality because "photographs by their own are always an interpretation, they do not replace facts from the past, and the photographer always act as a cultural filter to materialize the visual document" (Fernandes & Chaves, 2015, p. 79-80). In that sense, the analysis of a photograph enables other perspectives. For example, figure 3 presents a syringe and a vial. However, those products can be used for vaccines, serums and injectable drugs, which turn images ambiguous and make necessary the presence of subtitles or written information. In addition to the iconographic study and the investigation of social and historic dimensions evoked while record-

ing a photograph, the intention of who produced the image and social and technological transformations offer different possibilities for future research (Fernandes & Chaves, 2015).

The representation of black bodies and the presence of scientist women that are black is also perceivable on those photographs, such as in figures 1 and 4. Due to the historic of production of illustrative images of Caucasian men's bodies in books of anatomy during the 16th and 17th centuries of European renaissance, textbooks of natural sciences usually do not represent bodies of women and black people (Amaral, Camel & Guerra, 2025). The image of a black woman as a scientist who develops vaccines must be highlighted. However, the function of the image is illustrative. Therefore, it would be interesting to include photographs of black women scientist who are part of the history of science for pedagogic purposes.

The following figures 5, 6 and 7, classified as illustrations, present vaccination campaigns through drawings:

Figure 5

Drawing of a children's vaccination campaign.

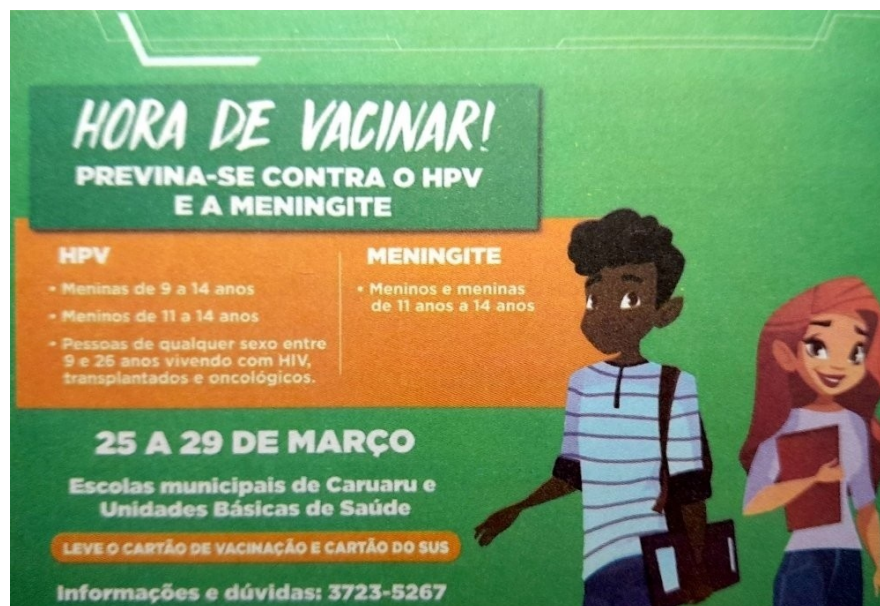


Source: Godoy, Dell'Agnolo & Melo (2020f).

Figure 5 is a drawing that presents information about a children's vaccination campaign. It has the function of illustrating that type of strategy developed by the Brazilian health system known as *Sistema Único de Saúde* (SUS). The image is in L2 and there are not subtitles because it is part of an activity of the textbook (Godoy, Dell'Agnolo & Melo, 2020f, p. 84).

Figure 6

Drawing of vaccination campaign against HPV and meningitis.

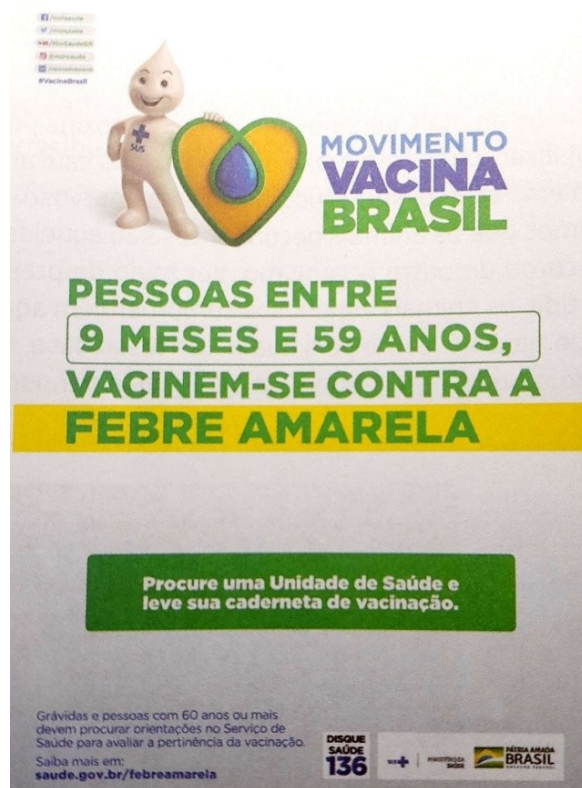


Source: Godoy, Dell’Agnolo & Melo (2020b).

Figure 6 is a drawing of a vaccination campaign against HPV and meningitis addressed to different ages and health conditions. It is in L1 and presents the following subtitle: “Campaign of the Ministry of Health for vaccination against HPV and meningitis” (Godoy, Dell’Agnolo & Melo, 2020b, p. 144).

Figure 7

Drawing of a vaccination campaign against yellow fever.



Source: Godoy, Dell’Agnolo & Melo (2020f).

Figure 7 presents a drawing of a vaccination campaign to prevent the yellow fever, and it contains the mascot known as Zé Gotinha of SUS. It is in L2 and has the following subtitle: “Poster from the Ministry of Health about the national vaccination campaign against yellow fever” (Godoy, Dell’Agnolo & Melo, 2020f, p. 82).

Health posters’ representations can be characterized as informative images. The identified posters in the collection of textbooks consist in posters of vaccination campaigns, which were elaborated by using iconographic elements. Specifically for this collection, they are drawings of vaccination campaigns for informative purposes because they present information like the type of vaccine being offered, dates, places and audience through iconographies adapted to the focus of each campaign (Pralon, 2019). For example, it is possible to see iconographies of children and Zé Gotinha, the mascot of SUS, in figure 5 because it is a children’s vaccination campaign. While in figure 6, iconographies of teenagers or adults are the focus. Figure 7 only presents the mascot of SUS.

Figure 5 is part of an activity of the textbook. Therefore, it poses the following question: “Analyze the poster and answer the questions. a) What does the poster refer to? b) Explain the importance of the action promoted by the poster for individual and population’s health in a general sense” (Godoy, Dell’Agnolo & Melo,

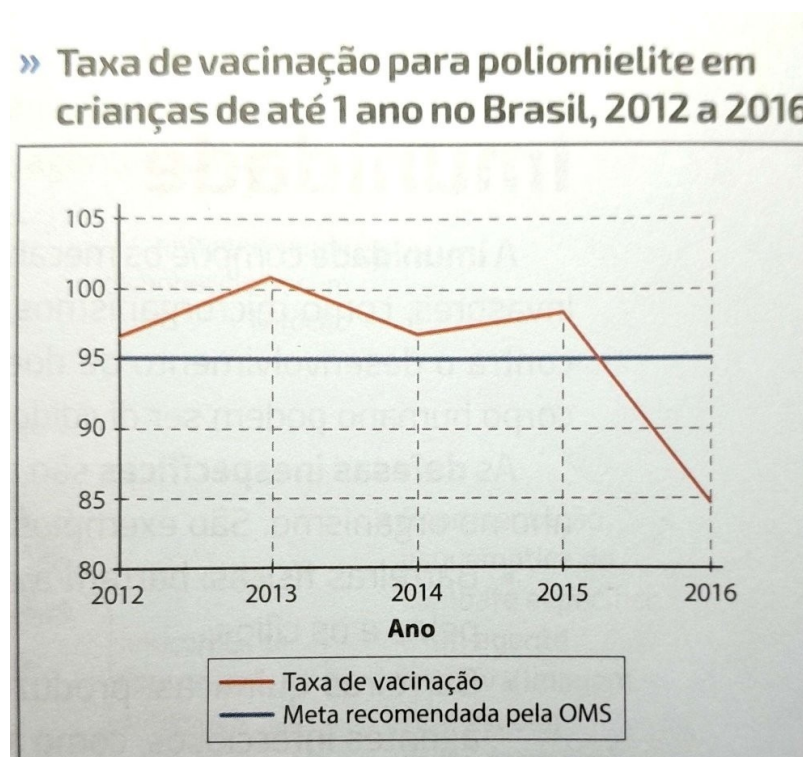
2020f, p. 84). That type of question can be characterized as context as an element in teaching processes because it is about the analysis of an image of a poster from SUS about a children vaccination campaign. Also, it presents an iconography of the mascot from SUS (Fernandes & Marques, 2015).

The activity relates the concepts of individual and collective health to the children vaccination campaign. For example, the vaccine against polio prevents infantile paralysis and it is essential for people's health. The prevention of the disease also is presented as an economic matter as it considers the context of daily routines because it is a resource available through a public health policy (Fernandes & Marques, 2015).

It can be observed in figure 8 a quantitative representation of numeric relations through different elements, such as lines, bars, sectors and tables:

Figure 8

Quantitative representation of a vaccination rate against polio.



Source: Godoy, Dell'Agnolo & Melo (2020f).

Figure 8 is a quantitative representation of a graphic about rates of vaccinations to prevent polio between the years of 2012 and 2016 in Brazil. The image can be found in L2 and it presents the following subtitle: "Rates of vaccinations against polio in children up to one year old in Brazil, 2012 to 2016" (Godoy, Dell'Agnolo & Melo, 2020f, p. 75).

Numeric graphics are representations that contain quantitative aspects and relations between numeric variables. The usage of graphics in scientific context has

the purpose of schematically representing a natural phenomenon in investigation. At school, graphics are languages that must be interpreted by students. Thus, it is important to explain the function of lines and curves to aid students to comprehend the numeric relationships with the scientific phenomenon. If students identify contradictions between the graphics and the world that they know, the decoding or interpretation will not happen in a satisfactory way (Lemos, 2018).

Another aspect to be considered about quantitative representations is the explicit mention of the image in the main text. It may have different levels of complexity, such as simple indications, such as look at the figure, or instructions to enhance the interpretation of the image (López-Manjón & Postigo, 2014). In the graphic of figure 8, it is possible to observe subtitles about the blue and red lines. Although the numeric variables of the graphic are not detailed, the text of the page in which the numeric representation is found invites the reader to analyze the graphic: “Analyze the graphic aside, which presents data about rates of vaccinations against polio” (Godoy, Dell’Agnolo & Melo, 2020f, p. 750).

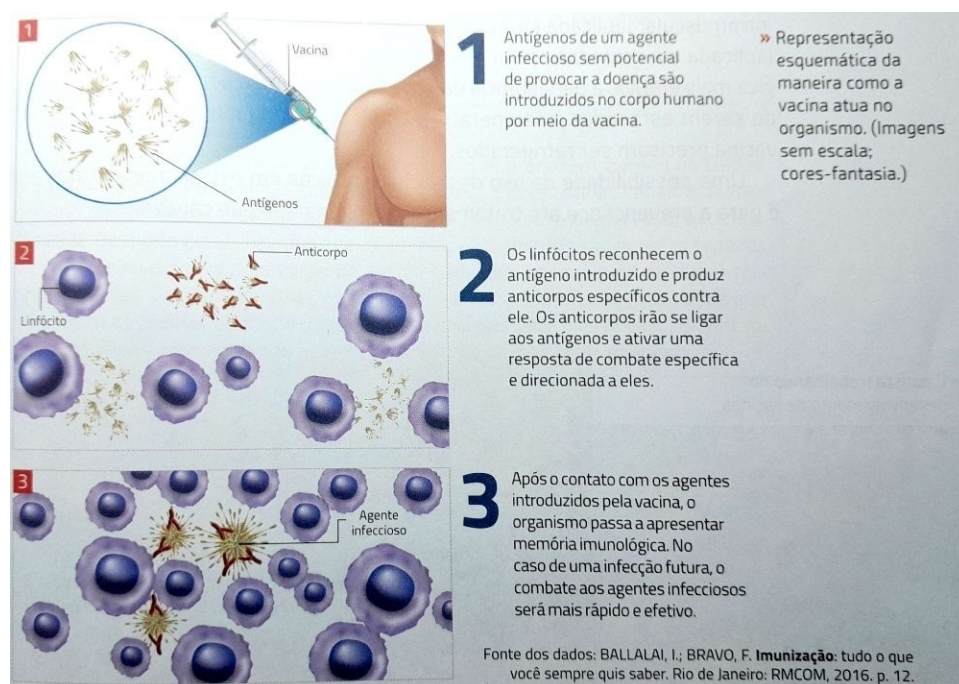
The analyzes of numeric graphics about rates of vaccination are part of an activity of interpretation of graphics to elaborate explanations about rates about vaccination coverage between the years of 2012 and 2016, stimulating reflections about possible consequences to the population’s health. There is an articulation between image, numbers and text to the construction of knowledge about vaccines. Similarly, Amaro, Azevedo & Borba (2023) highlight the importance of vaccination to control eradicated diseases and the combat of antivaccine movements on their analysis on textbooks, highlighting topics related to the dissemination of fake news, which superficially appears in the textbooks, as it can be seen in: “Among different reasons, there are the ignorance about its effects, the carelessness, the belief in fake news that claim that vaccination causes health problems” (Godoy, Dell’Agnolo & Melo, 2020f, p. 76).

The usage of different scientific languages, such as graphics and texts, can ease the students’ learning process while they elaborate their scientific knowledge in class, considering that visual resources are used to describe abstract concepts that can be applied to different contexts. Therefore, the comprehension about the specific languages used in natural sciences like codes, concepts, processes, vocabularies and terminologies, enables teachers and students to elaborate scientific knowledge in class through the usage of structures from the scientific language (Wartha, 2023).

It is observed in figure 9 a visual diagram that presents the evolution of vaccination effects within the human body:

Figure 9

Visual diagram of the immunization process through vaccination.



Source: Godoy, Dell’Agnolo & Melo (2020f).

Figure 9 is a representation of the immunization process of the human body through vaccination. The image is in L2 and its subtitle is: “Schematic representation of the way that vaccines act within the organism (images without scales; fantasy color)”. The text of the page of figure 9 mentions it directly: “The following scheme presents, in summary, how vaccines act within the organism” (Godoy, Dell’Agnolo & Melo, 2020f, p. 79).

Visual diagrams are used to represent a phenomenon. They are relevant as resources because they can be useful in the processes of teaching and learning in class. It is important that they present arrows, texts and well-structured subtitles to the students’ comprehension (Lemos, 2018). Figure 9 presents graphic elements that differentiate visual components and verbal components. Among some of the visual resources presented on the diagram, there are the usage of contrasting colors to denote different structures of the image, the magnification of antigens of vaccines in the syringe of application, and the usage of graphisms, such as lines and arrows, used to highlight structures.

The identified verbal components in the diagram are the reference to the representative characteristic of the image on the subtitle and the presence of labels that indicate the signalized structures through lines. For example, vaccine, antigen, antibody, lymphocyte and infectious vectors. The function of terms used as labels are explained in the text besides the diagram (López-Manjón & Postigo, 2014).

Another important aspect is the image of human body being generically represented in textbooks of natural sciences in anatomic and physiologic schemes. In European Renaissance, the knowledge about the human body on images caught attention due to the interest of artists in anatomic paintings and the representations of nature, considered by the time as the most faithful representation of natural phenomena. In that moment, the portraited human bodies were mostly of Caucasian men. Few works highlighted parts of the woman's body, especially the female reproductive system (Amaral, Camel & Guerra, 2025).

It is important to highlight the absence of verbal diagrams of vaccines. Concept maps are examples of that kind of representation, which is used to graphically represent concepts, propositions and keywords. Those elements are organized within geometric figures, such as circles, ellipsis and rectangles, connected by arrows or lines, which denote a hierarch between the keywords. That type of graphic representation shows aspects of a person's comprehension about a concept and can be used in teaching, learning, and evaluation processes because it allows the analysis of aspects of the cognitive structure of students through the organization and hierarchic integration of concepts taught in class (Queiroz, Bizzera, 2021).

Due to the importance of textbooks at school, the investigation of how topics related to the field of health are presented as words and images becomes relevant, as it can be seen with vaccine representations (Pralon, 2019; Lima, Oliveira & Rosa, 2020; Alves, Yamashita & Francisco-Junior, 2023). Visual grammar goes beyond the forms perceived by the vision. It involves cognitive processes related to sensorial perception, memory, thinking, analysis of information and learning (Barbosa, 2017). Thus, it is important to plan the usage of images to ease the processes of teaching and learning, considering the type of image, intention of authors, previous knowledge of students, activity, polysemy of images, context and content (López-Manjón & Postigo, 2014).

Finally, it is necessary to highlight the importance of the usage of images in educational activities and the necessity of different types of graphic representations to stimulate the elaboration of knowledge about vaccines by the students. For example, the access to those products in health services and public policies on that theme. It is also valid to highlight the necessity of formal education for biology teachers that contemplate different scientific languages, such as verbal texts, photographs, drawings, numeric graphics, tables, visual diagrams and verbal diagrams, considering that the relationship between a type of language and its meanings are not obvious (Amaro, Azevedo & Borba, 2023; Wartha, 2023).

FINAL CONSIDERATIONS

Graphic representations of vaccines were investigated through the qualitative approach of content analysis. There is a low variety of graphic representations of vaccines in the analyzed collection due to the predominance of illustrations. They can be photographs, which are the majority and have the function of illustrating the explanations in form of words. They usually do not add more information to

the topic. The identified drawings in the collection are posters of vaccination campaigns that present information about the vaccine being offered, dates, places for vaccination and targeted public. It is important to highlight the usage of one drawing identified in an activity of the textbook about the analysis of an image of a vaccination campaign.

Only one example of quantitative representation was identified as well as only one example of visual diagram. Numeric data and aspects of human body, such as cells and molecules, may be hard to comprehend due to the level of abstraction required to imagine these phenomena. Therefore, those representations can aid in the interpretation of that type of information. No representation classified as verbal diagrams were found, such as mind maps or concept maps, which are interesting techniques for the processes of teaching, learning and evaluation.

Accordingly, we highlight the importance of documental analysis of images present in school resources like textbooks and other ones. The research on textbooks is relevant because they are resources that aid in the processes of teaching and learning in class. They are distributed by the PNLD to schools and are sources of information which must be trustable and significant. Some possibilities for future research are the investigation about graphic representations on collections of textbooks, teachers' guide and other resources used at school in different segments of basic education.

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