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TRANSDISCIPLINARY EXPERIENCES OF ARTISTS AND SCIENTISTS THROUGH THE ILLUSTRATION OF BRAZILIAN MAMMALS

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ABSTRACT

There has been an essential dialogue between artists and scientists for many centuries. Even today, creating environments that favor the interaction of professionals from these two fields provides many potential opportunities to develop transdisciplinary experiences. In the present study, we describe the adventures of a partnership between the Rio de Janeiro Federal University Fine Arts School and the Oswaldo Cruz Institute, based on the report of a student in art education. The student illustrations of Brazilian mammals reflect on different aspects of these traits and the potential benefits of this interaction for scientific dissemination, species conservation, and art appreciation. The experience of the routine of the Laboratory of Biology and Parasitology of Reservoir Wild Mammals (LABPMR) and Mammalogical research, and the rethinking of scientific illustration as an art form, supported novel interpretations of the characteristics of Brazilian mammals and their role in the environment. The images were exhibited at events that promoted public health, scientific dissemination, and culture in both the Fine Arts School and the Oswaldo Cruz Institute.

Keywords: Artistic Illustration; ArtScience; Mammals.

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1 INTRODUÇÃO

When considering the interplay between Science and Art, we instinctively think of the Italian polymath Leonardo da Vinci (1452–1519). Leonardo defended the relationship between the two fields, also the naturalist paintings of the German painter and engraver Albrecht Dürer (1471–1528), who wanted to contemplate and illustrate the beauty of nature (GOMBRICH, 1995; DA SILVA, 2019). Observations of nature and the various manifestations of its different patterns, including geometric, numerical, and fractal configurations, are found in the works of Leonardo, Dürer, and other naturalists. These men inspired more recent artists and scientists, such as transdisciplinary relationship Margaret Mee (1909–1988), an English artist who devoted much of her life to illustrate the flora and fauna of Brazil (SCHANNER, 1998; DE ALMEIDA, 2014). In the early 20th century, Castro e Silva (187? –1934) was one of the first draughtsmen contracted by the Oswaldo Cruz Institute to illustrate scientific publications, producing a vast inventory of material on insects, protozoa, pathological anatomy, and helminths (OLIVEIRA; CONDURU, 2004; LACERDA *et al.*, 2016; COC, 2020).

During the Renaissance, which spanned the XIV and XVII centuries, many artists seeking to capture the beauty of nature were interested in its scientific aspects, such as studies in anatomy, light, shadow, and the representation of reality (GOMBRICH, 1995; SCHLESENER, 2016). The dialogue between science and art can also be seen in contemporary artistic movements, such as the Hyper-Realism movement, which is based on a faithful representation and the study of light, shadow, and colors, which makes the viewer question the reality of what is seen (FABRIS, 2013). Interesting examples of this approach include Ralph Goings' "Salt" (1989), the rhythmic works of Kinetic Art or Kinetism (PERISSINOTTO, 2000), as seen in Abraham Palatinik's "Objetos cinéticos" (*Kinetic objects*), Land Art, which has a transdisciplinary relationship with ecology and biology (SILVA; CRUZ; MEDEIROS, 2016), as seen in Robert Smithson's "Spiral Jetty" (1970), and Optical Art or OP Art, which often employs optical illusions (MANAIA, 2019), as in Bridget Riley's "Hesitate" (1964).

In Brazil, primary education is regulated by the National Curricular Base of the Ministry of Education (BRASIL, 2018), which establishes the essential learning requirements of the primary school student. Art teaching contributes to constructing the student's ability to think critically about the world. It contributes to citizenship by discussing themes such as respect for differences. Teachers must always be up to date with their pedagogical strategies and integrate inter- or transdisciplinary approaches in their classroom activities to achieve these objectives. In this context, SCHLESENER (2016) understands the expressive and sensitive functions of art, and its contributions to the other subjects in the school curriculum, and that, to develop critical thinking and "creative activities," it is essential to build imagination and perception - stimulated by art - throughout the learning process.

The present study aims to explore the importance of a transdisciplinary approach through the description experiences of an art student in one of the laboratories of the Oswaldo Cruz Institute. This experience provides insights into the interaction that contribute to the training of teachers and researchers and the development of the fields of both art and science. NICOLESCU (1999) and LAWRENCE (2010) consider that the construction of transdisciplinary studies involves presenting content *between*, *across*, and *beyond* the disciplinary structure, respecting local contexts, and developing intercommunicating action. In this context, artistic illustration contributes to biology teaching and has been revisited in recent studies to facilitate students' recognition of patterns in nature and biological diversity (RAPATÃO; PEIRÓ, 2016; ELLISON *et al.*, 2018). In the present study, we describe an interaction between the study of artistic illustration and mastozoology, the biological field that studies mammals. Mastozoologist are biologists that study anatomical patterns to classify

mammals, the ecological behavior of species, their conservation status, and the role of these animals in the cycle of zoonoses. These diseases are transmitted from animals to humans (CERQUEIRA, 2008).

2 METHODS AND CREATIVE PROCESSES

2.1 The collaboration between Oswaldo Cruz Institute and Fine Arts School

The collaborative agreement between the Oswaldo Cruz Institute and the Fine Arts School of the Federal University of Rio de Janeiro was established based on the mutual interests of the two institutions, as supported by the Extension Project P-A-R-A-N-D-A. This collaboration con-tinued through the "Curto Circuito: art, science and innovation", which was connected with the ArtScience Project, creating an opportunity for a scientific-artistic internship at the Oswaldo Cruz Institute. A group of 15 art students enrolled in different undergraduate courses at Fine Arts School, including Art History, Visual Communi-cation Design, Painting, Artistic Education with Fine Arts, and Art Education with Drawing licen-se, were selected to participate in the activities of the laboratories of the Oswaldo Cruz Institute, to experience the laboratory environment and the techniques of scientific analysis through immersion, between October 2018 and February 2019.

The first author of the present study was one of the students selected for this activity. She was in the sixth semester of a degree course in Art Education and was assigned to the Laboratory of Biology and Parasitology of Reservoir Wild Mammals (LABPMR) under the supervision of Paulo Sérgio D'Andrea and Jonathan Gonçalves-Oliveira. The proposal was for the student to experience the laboratory routines and rethink the relationship between artistic illustration and mastozoology, with the freedom to create and interpret new perspectives. This laboratory, on the campus of the Oswaldo Cruz Institute, in Rio de Janeiro, has a zoological collection of more than 18,000 specimens of wild mammals representing several taxonomic orders and different regions of Brazil

2.2 Planning visits to the Oswaldo Cruz Institute

In this transdisciplinary collaboration, the student was presented with specimens of four different mammalian orders in LABPMR to develop an artistic eye for the distinct characteristics of these mammals, understanding the techniques for the preservation of specimens, and the maintenance of a biological collection (Box 1).

Box 1 - Activities of the student during the university extension course (October 2018 - February 2019)

Week	Topic	Activity	Supervision
Week 1	Preparation and breeding of snails of the species *Biomphalaria glabrata*	Observation of experiments on *Schistosoma mansoni* infection models	Dra. Marta Julia Faro
Week 2	Preparation of mammalian intestinal endoparasites	Observation of the screening of endoparasites and the preparation of slides for light microscopy and taxonomic investigation	Dr. Arnaldo Maldonado Msc. Beatriz Elise
Week 3	Taxidermy	Observation of the preparation of wild mammal skins for the zoological collection	Dr. Paulo D'Andrea Rute Albuquerque
Week 4-6	Visiting the zoological collection of the order Didelphimorphia	Observation and illustration of the skins and skulls of specimens of Brazilian marsupials available in the zoological collection	Dr. Paulo D'Andrea Dr. Jonathan Gonçalves-Oliveira
Week 7-9	Visiting the zoological collection of the order Rodentia	Observation and illustration of the skins and skulls of specimens of Brazilian rodents available in the zoological collection	Dr. Paulo D'Andrea Dr. Jonathan Gonçalves-Oliveira
Week 10-13	Visiting the zoological collection of the order Primates	Observation and illustration of the skins and skulls of specimens of Brazilian primates available in the zoological collection	Dr. Paulo D'Andrea Dr. Jonathan Gonçalves-Oliveira
Week 14-16	Visiting the zoological collection of the order Carnivora	Observation and illustration of the skins and skulls of specimens of Brazilian carnivores available in the zoological collection	Dr. Paulo D'Andrea Dr. Jonathan Gonçalves-Oliveira

The student accompanied the activities of the researchers and illustrated Brazilian mammals based on: (i) Geographic region, in particular, northeastern Brazil; (ii) Taxonomy, including representatives of different mammalian orders, and (iii) The conservation status of the species (classified as vulnerable) according to the International Union for Conservation Nature (IUCN). This allowed the student to experience the transdisciplinary approach of a multidisciplinary team and the integration of scientists and artists from producing material with various interpretations. Three books, "Mammals of Brazil" (REIS *et al.*, 2006), "Guide to the Rodents of Brazil" (BONVICINO; OLIVEIRA; D'ANDREA, 2008), and the Red List of Mammals (IUCN, 2019) were used as references for the understanding of the general characteristics of the mammals, such as their behavior, geographic distribution, and conservation status. These references were used to compile information on the different mammals, such as their body size, the texture of their fur, and the specific characteristics of each order, as support for the investigation of the structures and the creation of artistic illustrations showing the traits and different elements of each species as faithfully as possible.

2.3 Techniques and materials used to produce the illustrations

Three techniques were used to produce the artistic illustrations presented here: (i) *Nanochrome* (pointillism and hatching): pointillism is a technique that uses dots to shade shapes, with a greater concentration of dots creating the sensation of a darker area. Hatching involves a series of lines, which may be either parallel, curved crossed, which can be used to the same effect; (ii) *Graphite*: also known as black lead or plumbagin, has multiple applications and is widely used for sketching, given that it facilitates

overlap with other media, although it is often used on its own for illustration work, given that it is more easily used to draw lines and dots than brushes. The graphite pencil can also be used for techniques such as pointillism and hatching, and (iii) *Watercolors*. This water-soluble paint is known for its transparency and versatility, including the that it can be used even after drying out. The tonal variation depends on its dilution with water, that is, the more water, the more transparent the paint.

The material used to produce the illustrations included 0.1 mm and 0.2 mm ink pens, graphite, and a mixture of graphite and watercolors or watercolors and colored pencil. The illustrations were produced on Canson 180g/m²paper, plain A4 size (210 mm × 297 mm) or, in the case of the watercolors, Canson 300g/m². The illustrations at an A3 scale (420 mm x 297mm) were produced initially with graphite on white Canson A4 sheets. Crossed, parallel or angular hatching, in which the lines converge or overlap to create tonal gradation, was used to create shading and the texture of the fur. The sketches were scanned at 300 dpi to produce illustrations at a high resolution. These techniques and materials have been widely used for both artistic and scientific pictures and are ideal for representing animals and natural scenes due to their objectivity and clarity of detail (SCHANNER, 1998; RAPATÃO; PEIRÓ, 2016).

3. RESULTS

3.1 The experiences of the art student

The Oswaldo Cruz Institute can reconcile the serious nature of its scientific research with the public dissemination of the advances produced by its laboratories in a welcoming environment created by contact with nature. In addition to the pleasure of witnessing the various links between science and art, connected through education, It was able to perceive the interest of the Oswaldo Cruz Institute in providing information to the general public, regardless of the age of the individual, through playful activities and experiences, which was clear from the many exhibition rooms scattered around the grounds of the institute. Cultivating scientific self-knowledge on the body's functions and diseases allows the public to learn about their environment and the different ways of preventing or treating conditions. This is supported by exhibits, educational materials, and hospital care facilities at the Institute.

During the first contacts between the Oswaldo Cruz Institute and Fine Arts School, the students visited some historic spaces, such as the Castelo Mourisco (Moorish Castle), where they had the opportunity to observe the library of rare works and visit two exhibitions – "Insetos Ilustrados" (Illustrated Insects) and "Oswaldo Cruz e Carlos Chagas" (Oswaldo Cruz and Carlos Chagas) in the temporary exhibition hall. The students also visited different sectors of the Life Museum, including the Science Park and the Pyramid, where they had fun with scientific experiments, the Epidaurus and its Laboratory of Perception, the fascinating world of the Butterfly vivarium, and the Stables, whose historical importance was highlighted during the visit. Students also had to attend lectures on biosafety in the laboratory and reflections on the craft of research and art. These activities were essential for correcting some preconceived notions and better understanding the ArtScience Project de-veloped at the Oswaldo Cruz Institute.

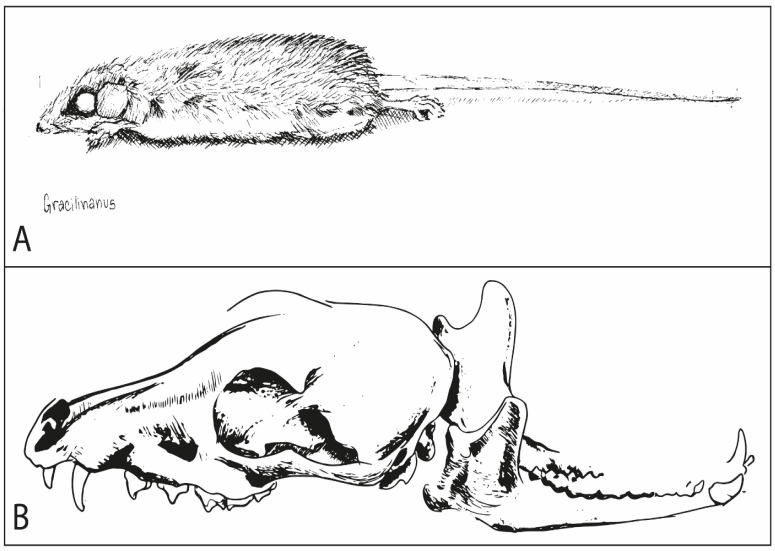
According to the student experience, sin-ce she was a child she has been fascinated by the world of animals and nature conserva-tion, to the point of considering taking a degree in biology or veterinary medicine when she grew up". At the same time, she doodled on walls and felt a passion for drawing and other forms of artistic expression. Her interest in building brid-ges between science and art, which has always accompanied her, and her fascination with the scientific illustration of animals, attracted the at-tention of the supervisor during the visit. They welcomed Juliana as a laboratory member and acted as official supervisor, answering her ques-tions about biology and inviting her to visit LA-BPMR.

The smells, colors, and activities found in this laboratory were quite distinct for the experiences of the student. As She entered the room, her first experience was the very characteristic smells of the autoclave and the waste from the vivarium, followed by the green of potted plants kept in an uncovered area, which reminded me of the external environment. Inside, the white walls of the laboratory appeared to dominate the whole scenario. The distinctive smell of the LABPMR mammal collection also caught her attention. The absence of this smell from some rooms and the ever-present white of the walls also made the student think about the colors found in the corridors of Fine Arts School and the scent of some of the materials they use when studying art.

On her first day, it was shown taxidermied specimens of several different species of small mammals and illustrated some of the rodents and marsupials (Figure 1–A). This was a unique opportunity for someone who has always been passionate about studying animals. During the day, the supervisors reiterated notions of biosafety, emphasized the importance of using gloves while handling the animals, and the care needed to avoid accidents when using certain types of material.

After establishing a schedule with the supervisor to learn a little more about the characteristics of the marsupials (Box 1), such as *Monodelphis domestica* and *Gracilinanus agilis*, the student was able to illustrate (Figure 1–B).

Figure 1 – (A) *Gracilinanus* genus. The first illustration was drawn in LABPMR. Pen, 0.2 mm, India ink. Juliana Gonçalves Moura, 2018 Oswaldo Cruz Institute, LABPMR, Rio de Janeiro, Brazil; (B) Illustration of the skull of a marsupial. Graphite. Moura, 2018. Oswaldo Cruz Institute, LABPMR, Rio de Janeiro, Brazil.



Describing another practice during first two visits to the laboratory, it was shown the glass jars in which the freshwater snail *Biomphalaria glabrata* are bred, and she was introduced to the helminth *Schistosoma mansoni*, together with the students of another research group (Box 1).

The student knew about Schistosomiasis, which is caused by the parasitic infection by *Schistosoma mansoni*, and how this disease is studied in the laboratory and the rodent hosts that maintain the infection cycle (Figure 2-A). She observed live snails interacting in the glass jars and took a closer look, using a microscope, a type of experience that is unavailable to her in the workshops at Fine Arts School (Figure 2 - B)

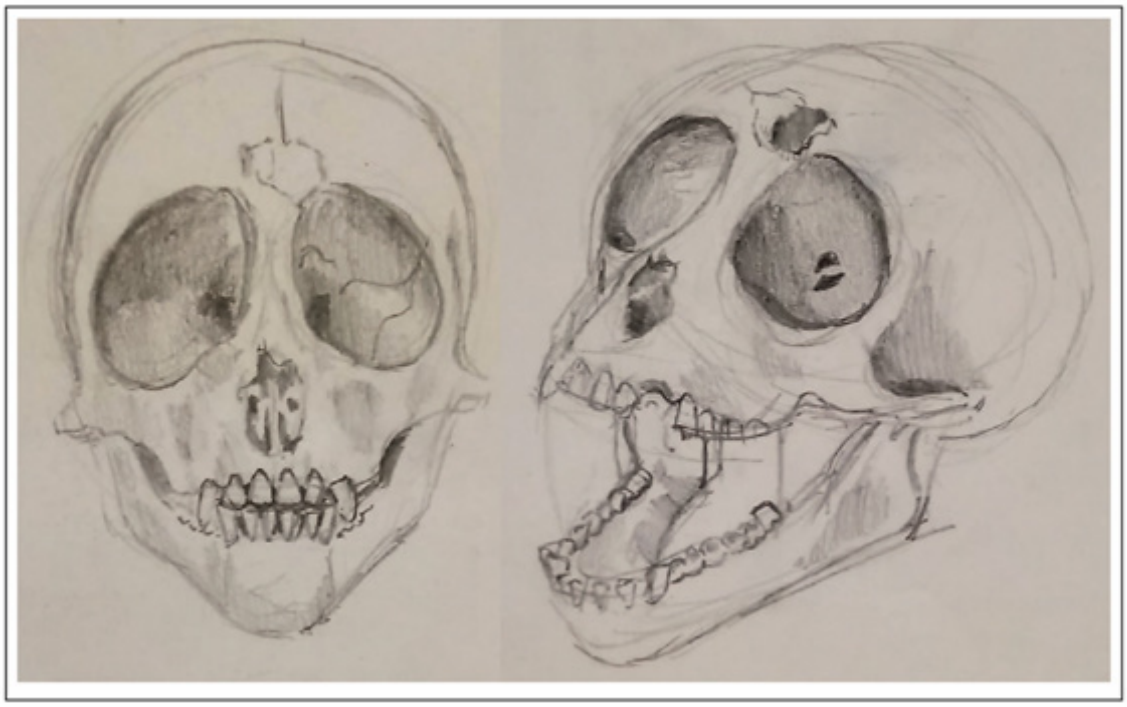
Figure 2 - (A) Glass jars containing the freshwater snail *Biomphalaria glabrata* to study helminth in-fection. Oswaldo Cruz Institute, LABPMR, Rio de Janeiro, Brazil. Source: the authors; (B) Sketches of the freshwater snail *Biomphalaria glabrata*. Pen, 0.1 mm and 0.2 mm, India ink. Juliana Gonçal-ves Moura, 2018. Oswaldo Cruz Institute, LABPMR, Rio de Janeiro, Brazil

During the following two weeks, it was observed and illustrated some rodents, such as *Thrichomys laurentius*, and it was sorted endo-parasites (worms) and prepared slides for taxo-nomic investigation by light microscopy. Accor-ding to the student, “it was interesting to have contact with the microscope and the light table used to illustrate specimens because it revea-led just how detailed and meticulous this type of work is and reflected on the similarities between the work of the artist and the scientist”. On this day, she painted with watercolors, a technique that she has not yet used in this environment, and tested the use of graphite to document the-se minuscule creatures (Figure 3).

Figure 3- Illustration of a helminth drawn using a microscope and light table. Graphite and waterco-lor. Moura, 2018, Oswaldo Cruz Institute, LABPMR, Rio de Janeiro, Brazil.

In the fifth and sixth weeks, it was shown the primate specimens and learned how these animals are taxidermied. During this period, it was explained how the skins are prepared for the zoological collection, including arsenic to preserve the material. It was shown the larvae of the larder beetle, *Dermestes lardarius*, which are used to remove the excess flesh from the bones of the skulls and skeletons that are to be included in the zoological collection. This process cleans the bones and leaves them ready for storage. During this period, she drew some skulls and the skins of the mammals (Figure 4).

Figure 4- Illustrations of primate skulls. Graphite. Moura, 2018. Oswaldo Cruz Institute, LABPMR, Rio de Janeiro, Brazil.



The experiences in this laboratory included not only the routine of a scientist, which allowed her to accompany interesting lunchtime discussions on subjects ranging from scientific papers to the ethics committee but also the environment of the Oswaldo Cruz Institute itself, where the diversity of plants and animals living on the grounds on the institution provides a nice ambiance. This intimate relationship with nature further enhanced her experience at institution.

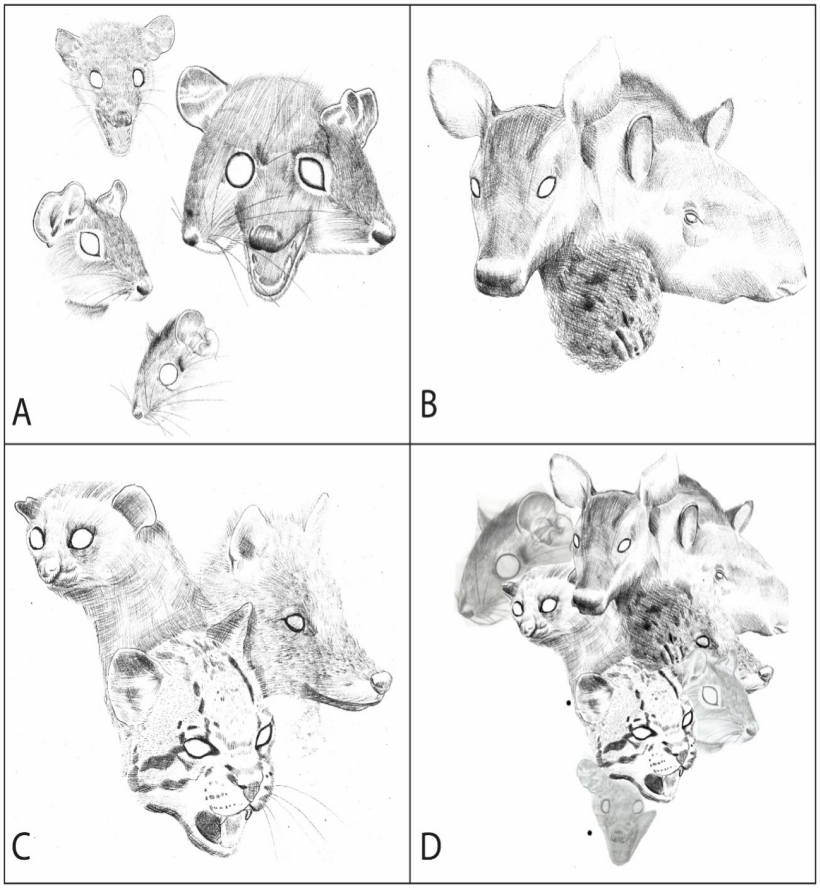
The most important part of the university is the opportunity to interact with people from other courses, places, regions, mindsets, and work environments. Participating in a project like the ArtScience Project allowed the student could interact with new individuals who are not undergraduates and work in entirely different fields of knowledge, which was undoubtedly a fascinating contribution to her training as a teacher. This exchange was relevant not only to her degree course, in Art Education, in which they constantly refer to individuality and the importance of communication between people (in particular, between the educator and the student), but also her development as a person, through new experiences, learning and changes.

In terms of artistic production, the period of the student at the Oswaldo Cruz Institute during the project brought her into contact with sensations, references, textures, and vivid colors that she would never have had access to on the internet, in addition, go stimulating her creativity and ways of expressing herself artistically. The similarities between the methods of the scientists and the creative process also caught her attention; that is, all the drawings were preceded by moments of observation, followed by the creation of hypotheses and, finally, ex-

periments recorded in the illustrations. DEWEY (2010) proposed that one of the essential characteristics of an artist is to be a born experimenter, which allows the artist to express their experiences uniquely, using the media available in their surroundings. Dewey goes on to affirm that "functioning experimentally" opens up new possibilities, both in the field of experience and by "revealing new aspects and qualities in familiar scenes and objects."

The choice of the subject matter for the illustrations that the student would eventually exhibit was derived primarily from the suggestion of supervisors, who recommended focusing on the mammals from the Brazilian northeast, that is, a geographic approach. Subsequently, she began to identify characteristics that these mammals had in common and also decided to focus on the different species' conservation status. The multifaceted heads were created to illustrate the similarities between the animals, and the titles were chosen to emphasize their standard features (Figure 5–A). The work "Vulnerable" showed mammals listed as vulnerable by the IUCN (Figure 5–B) and was inspired by Georg Cantor's Theory of Sets from 1874 (MARQUES, 2014). The work "Carnivores" illustrates mammals that share carnivorous feeding behavior, as well as being nocturnal (Figure 5–C). These groups (A, B, and C) are subsets of the universal set M, that is, the Mammals of Brazil, as presented in REIS *et al.* (2006) book (Figure 5–D).

Figure 5: (A) Mammals from the Brazilian Northeast. Graphite on 180g/m² sulfite paper (297x420 mm). Juliana Gonçalves Moura, 2018. Oswaldo Cruz Institute**,** LABPMR, Rio de Janeiro, Brazil; (B) Vul-nerable Brazilian mammals. Graphite on 180g/m² sulfite paper (297x420 mm). Juliana Gonçalves Moura, 2018. Oswaldo Cruz Institute, LABPMR, Rio de Janeiro, Brazil (C) Brazilian carnivores. Graphite on 180g/m² sulfite paper (297x420 mm). Juliana Gonçalves Moura, 2018. Oswaldo Cruz Institute, LABPMR**,** Rio de Janeiro, Brazil (D) Brazilian mammals. Digital Collage. Juliana Gonçalves Moura, 2018. Oswaldo Cruz Ins-titute, LABPMR, Rio de Janeiro, Brazil



The banners (Figure 6) were inspired by the Middle Ages to identify clans, families, or other groups (BATISTA, 2013). The idea of using images with multiple heads or faces is an allusion to medieval legends and myths of monsters with many faces (PINTO, 2007), which also interacts with the chosen format.

Figure 6: Fantastic Beasts. Cloth paint on unbleached cotton. Juliana Gonçalves Moura, 2018. Light Cultural Centre, Rio de Janeiro, Brazil.

After this initial period, the students participating in the project had the opportunity to exhibit their work at four events (in addition to informal presentations in the laboratory – Figure 7–A): during the National Science and Technology Week (NSTW) of the Oswaldo Cruz Institute (Figure 7-B), at the exhibition "The Spectacle of Things" at the Light Cultural Centre (Figure 7-C), in the Rare Works Library of the Moorish Castle (Castelo Mourisco), at the presentation of Project Vitrines in the Cultural Center of the Ministry of Health hall. The student was still working on the material in the laboratory, so it was possible to demonstrate part of the creative process. During Project Vitrines, the illustrations were displayed in a showcase in the Project Vitrines in the Cultural Center of the Ministry of Health hall. Other students participated in a roundtable, followed by the opportunity to talk about their research, experiences, and how the project had contributed to their art training. This exhibition was inaugurated with each artist talking about their work. This was an extremely positive experience for her, and an important personal achievement as an artist, given that this was my first opportunity to present her work to the public. Thus, she was able to experience the pleasure of an artist exhibiting their work and the apprehension of facing public opinion, the critical viewpoint of many people that she had never met before.

Figure 7– (A) The student at work on an illustration. Oswaldo Cruz Institute, LABPMR Rio de Janeiro, Brazil; (B) Participation in the National Science and Technology Week (NSTW). Drawings produced by the student. (C) The Spectacle of Things: The Exhibition. Fantastic Beasts. 2018**.** Light Cultural Centre, Rio de Janeiro, Brazil

In addition to these events, the student also had the opportunity to exhibit her work at the Biodiversid'Arte workshop, within the scope of the Chagas Express XXI project, in which she was invited to participate. This project refers to a group of animals hosts of Chagas' disease. It was exhibited color and black and white illustrations to help the general public identify these animals in their region (Figure 8 and Figure 9).

Figure 8: Colored illustrations exhibited by the Biodiversid'Arte project at the Chagas Express XXI. Juliana Gonçalves Moura, 2019. Watercolor and colored pencil on 300 g/m² paper: (A) *Didelphis albiventris* (White-eared opossum), (B) *Galictis vittata* (Greater Grison), (C) *Leopardus pardalis* (Ocelot), (D) *Leontopithecus chrysomelas* (Golden-faced Lion Tamarin), (E) *Sapajusapella* (Capuchin Monkey), (F) *Pseudalope xvetulus* (Hoary Fox), (G) *Callithrix jacchus* (Common Marmoset), and (H) *Priodontes maximus* (Giant Armadillo).

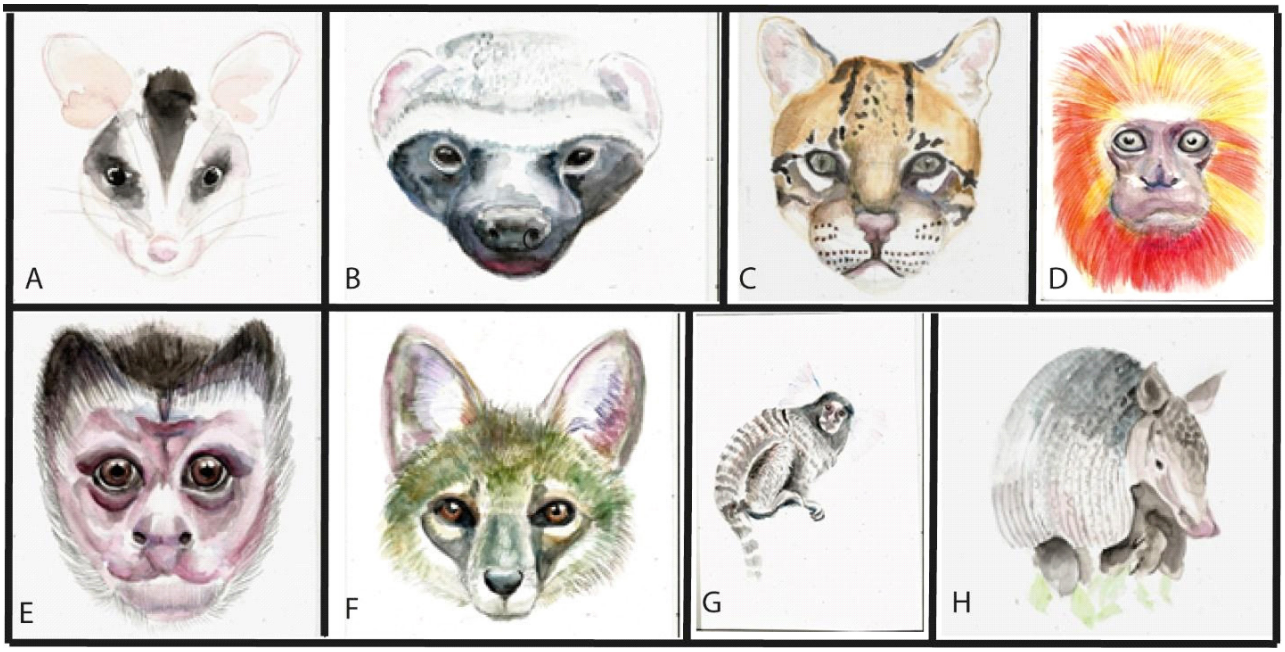
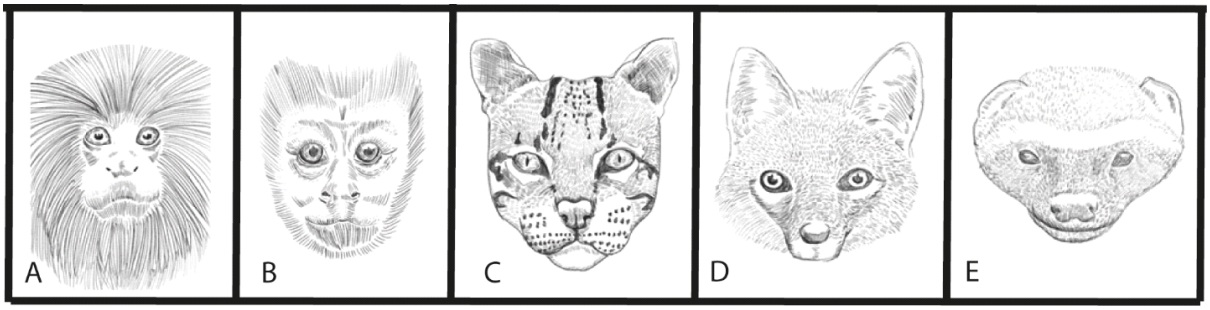


Figure 9: Digital illustration. Illustrations are used to make masks. Juliana Gonçalves Moura, 2019. Rio de Janeiro, Brazil: (A) *Leontopithecus chrysomelas* (Golden-headed lion tamarin), (B) *Sapajus apella* (Capuchin monkey), (C) *Leopardus pardalis* (Ocelot), (D) *Pseudalopex vetulus* (Hoary Fox), and (E) *Galictis vittata* (Greater Grison).



They created masks for the children to "dress up" as the parasite reservoirs animals. On 21–25 September 2019, other illustrations were exhibited during the National Science and Technology Week (NSTW) (Figure 10). The Chagas Express project allowed her to display her drawings in different Brazilian states, which was incredibly gratifying. This is highly satisfying to know that her work contributed to both cases' essential scientific dissemination process.

Figure 10: Artistic Illustrations displayed during the National Science and Technology Week (NSTW). Watercolor. Juliana Gonçalves Moura, 2019. Rio de Janeiro, Brazil: (A) *Akodon cursor* (cursor grass mouse); (B) *Marmosa paraguayana* (Tate's woolly mouse opossum); (C) *Gracilinanus agilis* (agile gracile opossum), and (D) *Oligoryzomys nigripes* (Black-footed pygmy rice rat).

4 DISCUSSION

The artistic-aesthetic experience described here was permeated by many emotions and reflections. The diversity of smells and colors, the procedures, and the participatory experiences contributed to an accumulation of knowledge, which stimulated research and the re-signification of the senses (DEWEY, 2010). ALVES (2005) created an exciting analogy that human beings carry two boxes within themselves, a toolbox and a box of toys. The toolbox is necessary for survival and contains many practical functions, whereas the box of toys provides pleasure. While the tools are used to open the box of toys, meaning can be found in both boxes, creating feelings and experiences.

There is no doubt that the participation of the students in the project was important for everyone involved, whatever their specific course or training, in terms not only of their capability to produce art – when linked to scientific research, the artistic process facilitates the development of new perspectives and understandings (ARAÚJO-JORGE *et al.*, 2018) - but also their personal growth. It is essential for everyone, especially artists and educators, to experience new environments, cultivate new perspectives, and stimulate untapped creative potential. That is why the laboratory environment was so important for the students, by allowing them to experience, first-hand, the subjects that they would observe and illustrate. This experience was significant for the education students by stimulating the creation of new methodological resources and content; after all, teaching also requires research (FREIRE, 1996) and the fundamental importance of scientific dissemination. In particular, topics related to health and disease, and laboratory research, can be discussed in the classroom at times other than in science lessons.

Related to this, it is also vital that teachers, especially art educators, seek to encourage and prepare their students to read images, an ability that is becoming increasingly important with the

ongoing intensification of the volume of images produced by modern technology such as mobile phones and the internet (SILVA, 2009; BARBOSA, 2014). Once again, as ALVES (2005) pointed out, the importance is not so much in reading the image but in teaching how to see.

According to BARBOSA (2014), the quality of the images produced by an artist is intimately related to their appreciation of the subject matter and the education of the senses. To appreciate this art, it will be necessary to educate the observer's gaze. The continuous development of the observer is required for free expression, and from this perspective, it is possible to develop fluency, flexibility, elaboration, and originality – the basic processes of creativity. All this is fundamental to cultural development and is only possible when high-quality artistic production is associated with the capability of the public to understand its significance.

The project presented here resulted in two principal types of educational products – illustrations of Brazilian mammals and pattern recognition – although it also encouraged investigative practices as an alternative approach to learning, in contrast with the more traditional concept of the teacher depositing knowledge in the student's mind. The activities developed during the project generated scientific actions that promoted the autonomy of the students, authentic thinking, and critical insertion (FREIRE, 1987). This practice of action and reflection intends to develop a vital perception of the world and the individual's place in this world as a means of creating an awareness of reality and self.

Images facilitate understanding (SILVA, 2009) and alert the public to the importance of certain issues in specific environments, including events that promote public health. In the particular case of scientific dissemination, the illustrations produced here contributed to essential questions, such as identifying the hosts of Chagas' disease and the conservation status of many Brazilian mammals. In particular, it was necessary to have the opportunity to appreciate the significance of the interaction between the fields of art and science. The expression of this interaction in, for example, the exhibition at the Light Cultural Center, was also an opportunity to stimulate interest in questions related to public health, reach out to different types of audience and facilitate communication between professionals from other areas, that is, arts and the biological sciences.

The experience also highlighted the value of the transdisciplinary approach, which enhanced each field of knowledge individually and obscured the boundaries between them. From the perspective of NICOLESCU (1999), the transdisciplinary experience of the *between* described in the present study is found in the combination of art education and biology, while the *across* is derived from the combination of the knowledge from these two fields, such as scientific illustration and the study of mammals. Finally, the *beyond* is encompassed by the artist's experiences in a research laboratory, the observation of specific questions, such as biogeography, conservation status, and zoonosis, and the dissemination of this content to the general public through the illustration of scientific exhibitions.

This approach supports non-linearity and reflection, involves intercommunicating action, and is based on practical activities, which may have far-reaching implications for complex issues in modern society, including the reconsideration of the content of the curricula of educational institutions (LAWRENCE, 2010). Just as the legacy of Leonardo da Vinci (and other artists) transcends a specific field, transiting between areas and extending beyond them, the present study was able to establish a successful fusion between disciplinary components and distinct fields of knowledge. It also reaffirms the importance of knowledge production by public universities; the experience in the learning process and the artist as an experimenter, as proposed by DEWEY (2010); of autonomy and encouragement of critical thinking addressed by FREIRE (1987), also related to the education of the senses and the value of observation highlighted by BARBOSA (2014).

5 CONCLUSIONS

From the successful partnership between Fine Arts School and Oswaldo Cruz Institute, it was possible to create a transdisciplinary interface between the artistic skills of an undergraduate student with the expertise of researchers from a biomedical research institute such as the Oswaldo Cruz Institute.

Through this experience, it is notable that it is possible to carry out various works of scientific divulgation, art exhibitions linked to health promotion, integrating the artistic illustration with the laboratory environment. This study also brought the knowledge of Brazilian mammals from an artistic perspective, creating bridges between biodiversity and art, exploring aspects of this group of animals and the importance of species conservation and their role in zoonoses.

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CONFLICT OF INTEREST

There is no conflict of interest in the research

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