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Inclusive educational methods in geosciences and paleontology for visually impaired individuals

Métodos educacionais inclusivos em geociências e paleontologia para pessoas com deficiência visual

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ABSTRACT

The present work shows methods of implementing inclusive education in geoscience and paleontology areas for blind and low-vision individuals, being considered a limiting science to this public due to the dependence of the sense of sight. Tactile resources, the use of techniques of high relief and color contrast in illustrations are essential for the development and learning of young people with visual limitations. Concomitant with the creation of materials, the work proposes that students, especially ones of all levels besides teachers can act as diffusers in the spread of the use of inclusion techniques, such as children from the schools of Alegre and Jerônimo Monteiro and undergraduates and teachers. They work at the Macroscopy Laboratory of the Geology course at UFES and at the Natural History Museum of the Southern State of Espírito Santo. In addition, the project reaches other states, such as schools in Rio de Janeiro city and Ouro Preto, Minas Gerais.

Keywords - Inclusive Education, Blind, Low-Vision, Geology, Paleontology.

RESUMO

O presente trabalho mostra métodos de implementação de educação inclusiva destinados aos indivíduos de baixa visão e cegos nas áreas de geociências e paleontologia, sendo considerada uma ciência limitadora a este público devido à dependência do sentido da visão. Recursos táteis, a utilização de técnicas de alto relevo e contraste de cores em ilustrações são imprescindíveis para o desenvolvimento e o aprendizado do jovem com limitações visuais. Concomitante à criação dos materiais, o trabalho propõe que videntes, principalmente discentes de todos os níveis e docentes, possam atuar como difusores na propagação da utilização das técnicas de inclusão, a exemplo de crianças das escolas de Alegre e Jerônimo Monteiro e graduandos e professores que atuam no Laboratório de Macroscopia do curso de Geologia da UFES e no Museu de História Natura do Sul do Estado do Espírito Santo. Além disso, o projeto alcança outros estados, como escolas da cidade Rio de Janeiro e de Ouro Preto, Minas Gerais.

Palavras-chave - Educação Inclusiva, Cegos, Baixa Visão, Geologia, Paleontologia.

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1 INTRODUCTION

In order to promoting an inclusive and didactic educational environment for elementary, high school and college students, models and tactile materials with texts adapted for low vision and written in Braille were built related to participatory educational methods and facilitators of the learning process. Such objects are used in activities at the Macroscopy Laboratory of the Department of Geology of the Federal University of Espírito Santo and at the Natural History Museum of the Southern State of Espírito Santo (MUSES).

According to Silva (2013), it is through pedagogical practice that the student can visualize the theory presented. Thus, models are an important learning tool and one of the great methodological facilitators in teaching.

However, for blind and visually impaired people, the applied teaching resources must be adapted to the absorption of knowledge. Oliveira, Biz and Freire (2002), emphasize the importance of building adapted resources for students with blindness and subnormal vision through the development of tactile and visual perception. Lederman and Klatzky (1987) argue for the wide reliability of the tactile modality through perception and interpretation through sensory exploration, surpassing the sense of touch.

For Grifing and Gerber (1996), the adaptive process is composed by the exploration of the full two-dimensional tactile development of the shape and interrelated parts of objects, the graphic representation and, finally, the use of a symbology system, such as the braille alphabet, making up the full development of tactile mobility. This paper proposes the implementation of inclusive education techniques for blind and low vision people using examples in the areas of geoscience and paleontology. In addition, it proposes the creation of materials and methods that help in the dissemination, in which students, from elementary school to university, act as tools for the spread of inclusive education, especially in the state of Espírito Santo and other locations in southeastern Brazil.

Much geological and paleontological information is inaccessible to people with limited vision, such as the color of minerals, the color tone of geological maps, the observation of fine level curves in maps, and the morphology of organisms.This work proposes the creation of inclusive materials to be used in classrooms, workshops and events, using techniques and methodologies of tactile perceptions, such as the internal structures of the earth, volcano and dinosaurs (Parassaurolophus). Thus, the interest in the learning of geosciences as well as inclusive education is combined, as they are very much addressed and curiosity-arousing topics. Such interests in geoscience-related themes can be seen in experiments at the Natural History

Museum of the Southern State of Espírito Santo (MUSES), where questions from visitors were frequent.

It is noteworthy that one of the objectives of this project is to encourage visually impaired students, from elementary to higher education, to act as mediators in the profusion and learning of inclusion practices, to act in the development of visually impaired people.

2 MATERIALS AND METHODS

The structuring of the resources to be used was made through surveys and efficiency tests of tactile and recycled materials, and models were built with the following themes: volcanoes, Earth's internal structure and dinosaurs. High relief images and explanatory texts referring to the three themes above were also recreated. The tactile volcano (Figure 1), 21 cm height and 23.5 cm width, was constructed of pieces of wood glued with white glue and sanded texture in the outer part, assembling the desired shape and texture. The pore filling in the bonding process was done with sawdust and white glue. For finishing, wood dye, acrylic paint and silicone were used, all materials being reused from discarding woodworking material, providing low cost. In the schematic section representing the internal structure of the Earth (Figure 2), a 15 cm height and 8 cm “V shaped” wooden base, sawdust, crepe paper, gravel dust, silicone, gel, 0.6 mm transparent PVC plastic, super glue, white glue, A4 colored paper and acrylic paint were used.

In addition, two 11 cm spheres were recreated, one simulating the shape of the Earth Planet and a half sphere to show the internal subdivisions (crust, mantle and core) represented in EVA material. The 90 cm tall dinosaur, *Parassaurolophus* (Figure 3) was assembled in wood cut into the shape of the animal's bones in a snapping manner.

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Figure 1. Sectioned tactile volcano model depicting the volcanic cone, magmatic chamber and crater. Source: the authors.

Figure 2. Spheres simulating the shape of Earth Planet and schematic section representing the internal structure of the Earth. Source: the authors.

Braille cells (Figure 4) with dimensions of 12 x 7,5 x 2 cm were made from reused construction wood and six holes were made to teach the Braille alphabet to the students.

The images and the explanatory texts were developed on A3 paper and 180g/m² A4 size paper using colored EVA sheets, white glue, retro projector marker, Slate and Stylus. Also, images of the volcano (Figure 5), the internal parts of the Earth (Figure 6) and the

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dinosaur (Figure 7) were developed to allow the reproduction of the materials by teachers and students.

Figure 3. *Parassaurolophus* dinosaur built in wood. Source: the authors.

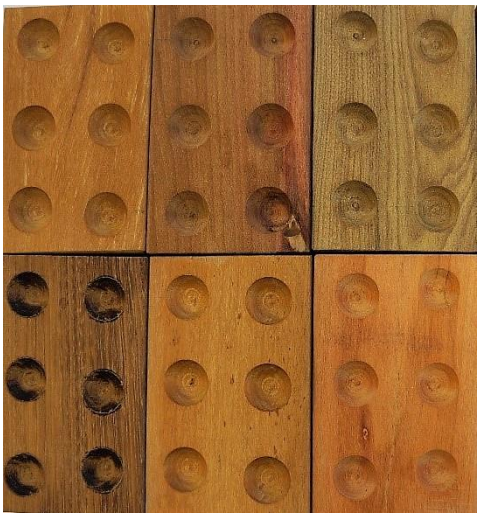

Figure 4. Wooden cells for Braille alphabet learning. Source: the authors.

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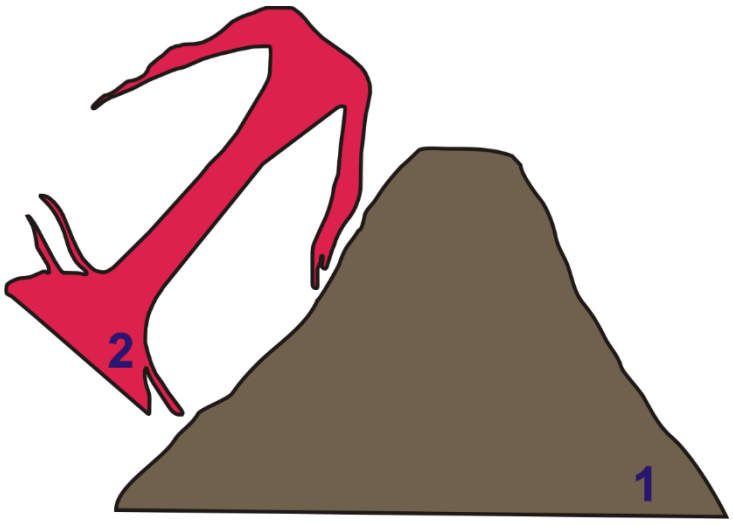

Figure 5. Mold for reproduction of the tactile image of cone volcano, magmatic chamber, crater and lava.

Source: the authors.

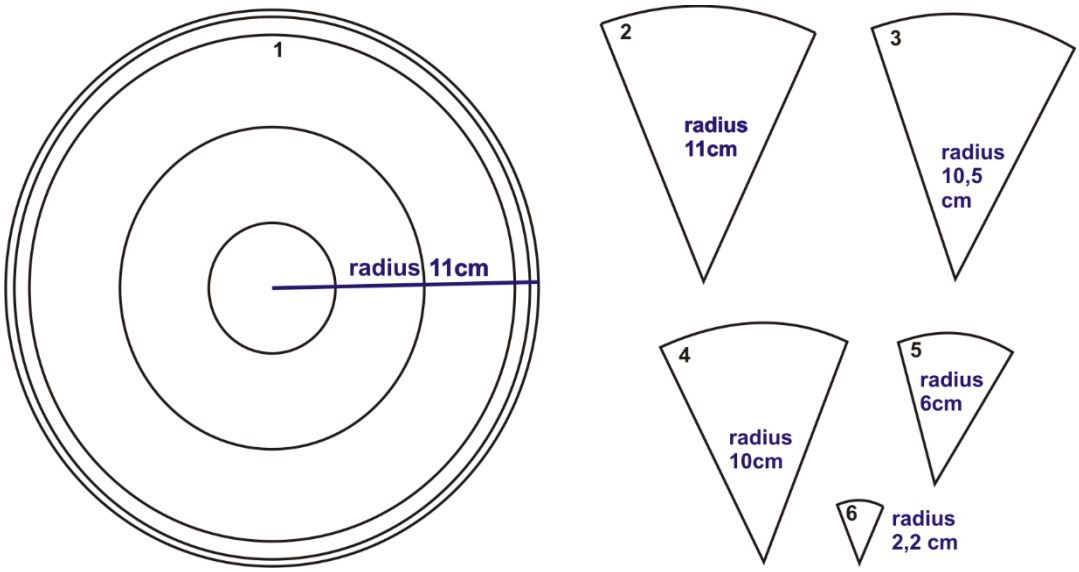

Figure 6. Molding of tactile images of Earth's inner layers into circular and triangular sections, providing comparisons of their proportions.

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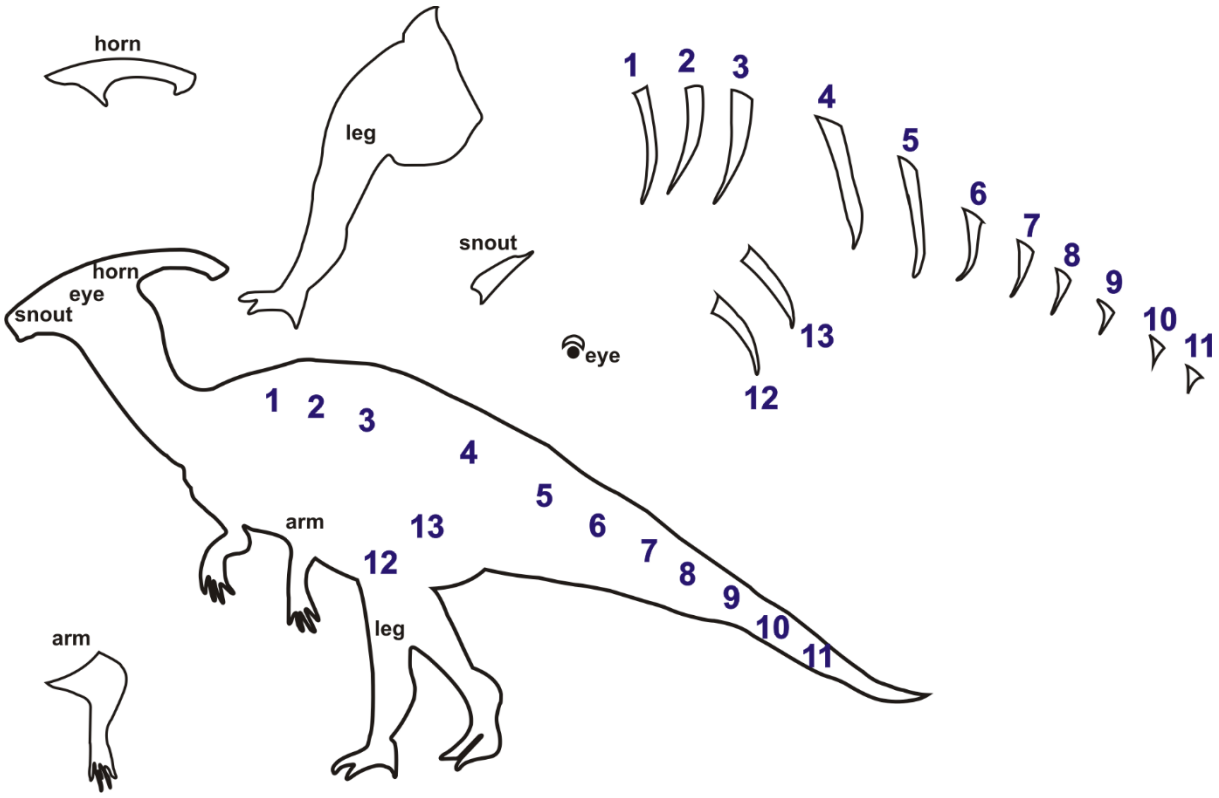

Figure 7. Molds for the image of the dinosaur *Parasaurolophus* in high relief. Source: the authors.

3 ACQUIRED RESULTS

3.1 ACTION LOCATIONS

The activities and methodology were implemented at the Macroscopy Laboratory of the Geology course of the Universidade Federal do Espírito Santo and at the Natural History Museum of the Southern State of Espírito Santo.

The Macroscopy Laboratory was set up in 2009 with the construction of the Geology Building belonging to the former Centro de Ciências Agrárias of the Universidade Federal do Espírito Santo (ES) on the campus of Alegre. Today it is part of a new center called the Centro de Ciências Exatas, Naturais e da Saúde. During the implementation phase, several samples were obtained from the Oceanography, Geography and Biology departments of the UFES campus of Goiabeiras, Vitória and several researchers. The Lab's collection has been gathering more samples over the years from donations, purchases, loans and sample collection programs. In addition, the collection includes didactic materials, such as models, crystallographic models and fossil displays. The Natural History Museum of the Southern State of Espírito Santo was created in 2013 in Jerônimo Monteiro - ES, which mission is to disseminate the natural sciences, bringing the public closer to academia through exhibitions, workshops and visits to collections (Figure 8). MUSES has collections of geology, paleontology, botany, zoology and

parasitology. In the geoscience areas, visitors will find samples of meteorites, igneous, sedimentary rocks, minerals of various classes, cut gemstones, as well as a vast collection of fossils and replicas. In addition, MUSES offers several training courses for monitors and mediators. Both spaces are important for the south Espírito Santo community, especially in the communication and dissemination of geosciences. Moreover, such places become conducive to the implementation of inclusive practices for blind and low-vision people, with geological and paleontological experiments and examples. The project is still being implemented in schools of and universities in Ouro Preto and Rio de Janeiro, from the assembly of didactic pieces adapted to visually impaired people.

3.2 STUDENT INTERACTION

Elementary students and undergraduates of UFES geology and biology courses have learned, through text and wood-cell practice, the Braille alphabet, how to deal with a person who has vision difficulties, as well as construction of affordable materials.

The importance of textures and shapes for the execution of tactile materials has been shown, such as the volcano made of wood, such as the silicon lava flow and the structure with more porous material; the sphere, sectioned in half and the profile of the earth's internal structure, all showing the geochemical differentiation (crust, mantle and core); the representation of *Parassaurolophus*, with the wooden parts showing the dinosaur morphology, such as position, limbs, ribs and skull cavity.

Figure 8. Exhibition of didactic materials in workshops of the MUSES. Pictures of the authors.

High relief and color contrast illustrations were made, related to the same themes described above. This technique has been carefully explained to students as it is intended for people with low vision. Activities of this technique were performed with elementary school

students, using A4 paper, glue, scissors and EVA paper. In addition, two types of informative texts were generated to encourage reading and learning of the Braille alphabet. For the first text, font size 24 was used and for the second text, for completely blind people, it was made in Braille with using Slate and Stylus.

4 CONCLUSION

It is concluded that the development and application of inclusion practices can boost learning and encourage interest in the geosciences and paleontology of blind and low vision students of primary education in southern Espírito Santo and other locations in southeastern Brazil. With the use of tactile and color-contrasted features, one can stimulate the curiosity of special students about volcanoes, the inner layers of Planet Earth and dinosaurs, themes that are very successful with children. The work also made sure that all (elementary students, undergraduates and teachers) can act as diffusers in the learning of inclusive education and that it should be part of the daily education in Brazil.

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