

# TEACHING SCIENCE THROUGH A CD-ROM ABOUT SPELEOLOGY

## ENSINANDO CIÊNCIA ATRAVÉS DE UM CD-ROM SOBRE ESPELEOLOGIA

**Rubiana Passos Custódio (1), Christiane Ramos Donato (2), Mário André Trindade Dantas (3), Marlécio Maknamara (4) & Ana Paula do Nascimento Prata (1)**

(1) Departamento de Biologia, Centro de Ciências Biológicas e da Saúde, Universidade Federal de Sergipe, São Cristóvão SE.

(2) Colégio de Aplicação, Universidade Federal de Sergipe, São Cristóvão SE.

(3) Instituto Multidisciplinar em Saúde, Universidade Federal da Bahia, Vitória da Conquista BA.

(4) Centro Educacional, Universidade Federal do Rio Grande do Norte, Natal RN.

Contatos: [rubiana.passos@gmail.com](mailto:rubiana.passos@gmail.com); [christianecrd@yahoo.com.br](mailto:christianecrd@yahoo.com.br); [matdantas@yahoo.com.br](mailto:matdantas@yahoo.com.br); [escrevequeeuleio@yahoo.com.br](mailto:escrevequeeuleio@yahoo.com.br); [apprata@gmail.com](mailto:apprata@gmail.com).

### Abstract

The objective of this work was to develop a teaching resource that will facilitate the approach of Speleology in science classes. This science is rarely covered by science textbooks, that is why build a teaching resource about this science is so important. The State of Sergipe, northeastern Brazil, has over fifty registered caves, and this kind of environment are differentiated ecosystems. Thus, in order to improve the study of this subject in the classroom and to contextualize with the local reality and other subjects (e.g. ecology, environmental education, tourism) in the school curriculum, it was decided to build up a CD-ROM resource.

**Key-Words:** Teaching Resources; Caves; Sergipe; Brazil.

### Resumo

*O objetivo deste trabalho foi desenvolver um recurso didático que possa auxiliar o ensino de Espeleologia nas aulas de Ciências. Esta ciência raramente é abordada nos livros textos de Ciências, por isso é tão importante à construção de um recurso sobre este tema. O estado de Sergipe, nordeste do Brasil, tem aproximadamente cinquenta cavernas registradas, e este tipo de ambiente representa um ecossistema diferenciado. Deste modo, intencionando o estímulo do ensino de Espeleologia em sala de aula e contextualizar com a realidade local e outros temas abordados no currículo escolar (e.g. Ecologia, Educação Ambiental, turismo) foi construído um CD-ROM sobre este tema.*

**Palavras-Chave:** Recursos didáticos; cavernas; Sergipe; Brasil.

## 1. INTRODUCTION

Speleology can become an effective tool for education in elementary school (Rodrigues, 2007), because during this period the children, with their activities, aim to conquer the world (Lievegoed, 2001 *apud* Rodrigues, 2007). In the 7 to 12 years old age group it is important to execute educational work from nature excursions. The visitation of caves is important in pedagogical field practices for the primary, secondary and higher education (Marra, 2001 *apud* Ferreira et al., 2008). In collaboration with this idea, Morgado et al. (1996 *apud* Ferreira et al., 2008) mention the importance of the use of informal knowledge from the students about the caves in developing practices that aim to use the underground environments as a basis for teaching subjects of Elementary and Secondary Education. Numerous associations can be made between the processes occurring inside the caves and the contents

of subjects such as History, Geography, Biology, Chemistry and Physics (Ferreira et al., 2008).

The natural underground cavities hold numerous biotic and abiotic characteristics that make them attractive for the anthropic use (Ferreira et al., 2008). One of the attractive features of natural cavities are speleothems, which are formed by mineral deposits in caves through chemical processes of dissolution and precipitation. Speleothems could be represented by: stalactites, stalagmites, columns, stone flowers and a multitude of other types. The speleothems can cover roofs, floors and walls of caves, causing the admiration of visitors and curiosity of researchers (Lino, 2001).

These formations adorn the cavities, increasing their touristic potential and sometimes religious, given the similarity in the popular imagination, of some speleothems with sacred or zoomorphic images. The richness in abiotic

characteristic, such as speleothems, raises several Brazilian caves among the most beautiful in the whole world (Karnopp et al., 2007), such as *Gruta da Torrinha* cave and *Poço Encantado* cave, both located in the state of Bahia.

In Sergipe, northeastern Brazil, the studies regarding Speleology are recent, focusing mainly on the invertebrate fauna (e.g. Santana et al., 2010), cave vertebrates (e.g. Ferreira et al., 2009; Dantas & Donato, 2011), and conservation of the cave environment (Donato & Ribeiro, 2011; Donato et al., 2012).

Thus, it is important to foster Speleology as an area of knowledge and promotion of natural resources because it aims, in a general manner, to promote the sustainable use of the cave environment through mechanisms that effectively contribute to its conservation (Marra, 2001 *apud* Rodrigues, 2007).

Based on this assumption, didactic material involving a subject rarely addressed in textbooks can be a tool that could complement the teaching of science. According to Krasilchick (2004) and Delizoicov et al. (2011), the textbook continues to prevail as the main working tool of the teacher and mediator in the written communication between the teacher and student. Thus, this courseware emphasizes the memorization of isolated information, endorsing the importance of content traditionally exploited and exposition as the main form of teaching (Delizoicov et al., 2011).

The book must be the basis for class discussion and not just an inert source of information (Krasilchick, 2004). However, it is evident that the teacher cannot be held hostage of this isolated source, even as its quality increases (Delizoicov et al., 2011). Executive bodies such as the Departments of Education and the Ministry of Education (MEC) often refer to the teacher several alternatives to the textbooks (Bizzo, 2009).

It is a teacher's duty to select the best material and how it can be used in face of his own reality (Bizzo, 2009), as the teacher is, above all, the organizer of activities. Therefore, the greater the access to alternative materials, the greater will be the opportunity to find the most appropriate ones, taking full responsibility for choices, necessary adjustments and the creation of new alternatives, when needed (Delizoicov et al., 2011).

Bizzo (2009) reinforces the amount of materials that are available to the teacher, in order to improve the quality of the work, such as the paradidactic textbooks, videos and software. The universe of paradidactic contribution, like books, magazines, newspaper supplements (print and

digital), CD-ROMs, educational and scientific dissemination TVs and web network should be more present, in a systematic way in school education (Delizoicov et al., 2011).

Over the past five years, the community follows the production of teaching materials that, in one way or another, include the latest knowledge, which is already being used, although by a minority of teachers (Delizoicov et al., 2011). Therefore, when the teacher uses a technological resource as a source of information or as a didactic resource for the teaching activity is also enabling students to learn about social practices that use technology and develop skills and attitudes relating to technology in their own lives (Conde et al., 2003).

In the state of Sergipe, didactic resources for the teaching of science have already been produced. Among them: paradidactic books (Ferreira, 2011), educational games (Trindade et al., 2013), tales (Dantas & Torello, 2009), and CD-ROMs, dealing with the fossils from Sergipe (Dantas & Araujo, 2006), the ecosystems found in Sergipe (Oliveira et al., 2013) and the fauna found in the caves of Sergipe (Donato & Dantas, 2009).

Throughout the research developed with the CD-ROMs, there were cited advantages in using this type of complementary teaching resource, such as the possibility of being used in the classrooms as support material and/or its use by part of the students as a self-explanatory and interactive feature (Dantas & Araújo, 2006); it can be transported from one place to another and be used in most microcomputers; it is financially accessible, due to the low cost of its reproduction; and, finally, the production of this resource has been a productive field of academic work (Conde et al., 2003).

It is important to stress that the means, in this case the technological resources, are inefficient if they are placed in education as the most important part of the teaching-learning process. It is known that the CD-ROM in isolation does not have the ability to modify and improve education (Donato & Dantas, 2009). Thus, the use of multimedia resources (CD-ROMs) should not be seen as the solution to all the problems of education, but as a valid and important tool in the construction of a new teaching methodology, in which the teacher plays a key role in guiding students, but no longer is the only source of knowledge (Dantas & Araújo, 2006).

With this perspective, the objective of this work was to present a teaching resource that will be able to facilitate the approach to Speleology in science classes.

## 2. METHODOLOGY

The *Toca da Raposa* cave, object of this study, is registered in the Sociedade Brasileira de Espeleologia as SE-002, and is located in the *Manoel Roque* ranch, a private property in the municipality of Simão Dias. This cave is made up of four morphological compartments: a small room, just after the entry; a large lounge; a branch of mazes and a final hall; a total of 128.30 m long (Ferreira et al., 2009).

The information contained on the CD-ROM was searched in books, scientific papers and abstracts published in conference annals. The images composing this teaching resource were photographed by two techniques, which are: the *QuickTime Virtual Reality* (QTVR) and the *Stereophotography* (3D). The QTVR consists of using spherical projections of panoramic images that are assembled from individual photographs and the *Stereophotography* consists of obtaining two images taken at some distance from each other which are then combined giving a sense of depth to the scene (Morato, 2009). After obtaining and preparing the images, the CD-ROM was created.

For the construction of the CD-ROM, we used the *Microsoft PowerPoint* software, version 2007. It is a tutorial, self-explanatory program, and can be used both by the student, without assistance, and by

the teacher inside the classroom, as a teaching tool about the cave fauna and/or geomorphology (Donato & Dantas, 2009). The choice of the *Microsoft PowerPoint* software made the cost of preparation and reproduction of the CD-ROM very low (Conde et al., 2003).

## 3. RESULTS

The result of the research was a CD-ROM, built to cover information about *Toca da Raposa* cave found in Sergipe state. In its main screen (Figure 1) can be found topics which were developed to bring to the students a knowledge of the subject in a clear and accessible way, not leaving aside the scientific knowledge. Information about each item were selected and rewritten with a clear language, and the photographs were chosen assisting in the visualization of the environment, facilitating interaction with it.

The CD-ROM has features that attract the attention of those who handle it: keeps the student participating in the progress of the animations; it is an interactive material, which students will use according to their own learning time; and has images, sounds and videos that can interact with the concepts presented. Thus, learning can be built according to the time and personal curiosity of each student, preserving their individual characteristics.



Figure 1: Main navigation screen on the CD-ROM.

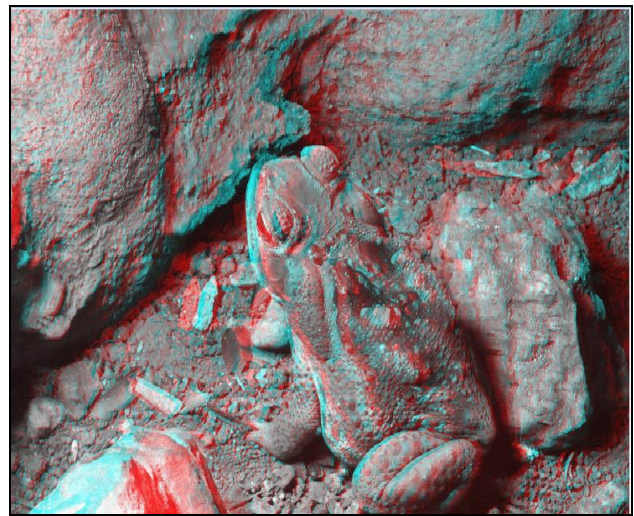
Through a simple language that contextualizes scientific concepts and a figure that brings the notion of how a cave is formed, the student can build up the idea of how the process of forming a cave is and which elements act on it. This favours the use of interdisciplinary approach because multiple sciences explain in a complementary way the process of formation of caves.

On the CD-ROM there were also used photographs with techniques that assist for a better visualization of the caves. The picture shown in Figure 2 was made using the *Stereophotography* technique (3D), which gives a sense of depth to the scene, making the image closer to real. In view of this, students can see pictures and meet the vertebrates, invertebrates and fossils that are typical in some caves. In parallel, there is a text with general information about these animals, such as the scientific and common names, size, distribution, feeding habits, behaviour, among others. The goal is to list the representatives of the fauna of the studied cave.

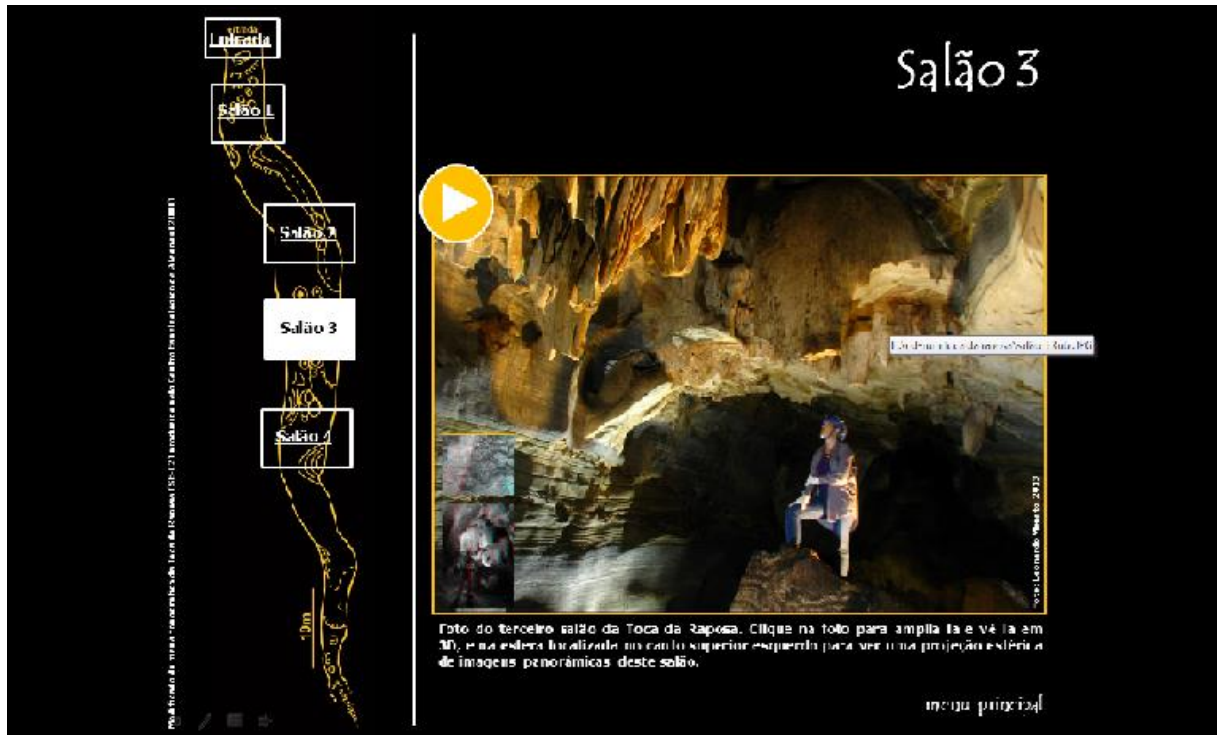
Figure 3 shows the map of the cave used as the object of this work. On the map there are links that direct the user to images of each of the environments of the cave. They are spherical panoramic images that can be rotated up to 360°, and 3D images of animals and speleothems, such as stalactites, stalagmites and columns. This way, the student can meet the cave entrance from the outside and its four halls. This will enable the learner to

have a virtual concept of the cave, and to meet its main features.

There is also in the CD-ROM a topic called “publications” where can be found links to complete papers (PDF version) about the *Toca da Raposa* cave, published in national events and in scientific journals, related to Zoology, Paleontology and Ecology. This topic is important because it shows what has been published about this cave, showing how recent is the work in this area of science and, specifically, in this cave, as stated by the authors Santana et al. (2010); Ferreira et al. (2009); Dantas & Donato (2011).



**Figure 2:** 3D figure (anaglyph) of a toad (*Bufo* sp.) found in the *Toca da Raposa* cave.



**Figure 3:** CD-ROM screen showing the map of the *Toca da Raposa* cave and links that redirect the user to 3D e QTVR images.

The produced CD-ROM offers an interdisciplinary resource and can be used in primary and secondary education to complement the lessons on science and biology. It can also be accessed by anyone with an interest in the subject. In science classes, it can be used to complement the classes through a subject contextualized in the reality of the student. The students can have contact via CD-ROM with the caverns from their reality and this resource can be used to develop the conceptual learning of Speleology.

#### 4. CONCLUSIONS

In Sergipe there is a deficiency of didactic resources for teaching Speleology. Given this assumption, and to assist understanding and disseminating this science which studies caves, from its genesis and evolution to the understanding of its physical, chemical and biological environments, a

CD-ROM was built to be used as a teaching resource to supplement the book adopted in the classroom. Understanding that additional teaching resources are important in the teaching-learning process, it is necessary that teachers use those materials to assist in their classes, bringing a differentiated and contextualized knowledge for the teaching of science.

Finally, Speleology can inspire other ways of teaching the syllabus of science, and can encourage students to learn about the wildlife that live in the caves, as well as stimulate discussions about conservation of the environment and environmental education. The theme explored on the CD-ROM is an interdisciplinary subject, and will prepare the students to be able to understand various segments of Science, and especially to make them disseminators of such knowledge, helping them understand why we need to conserve the environment around us.

#### REFERÊNCIAS

- BIZZO, N. **Ciências: fácil ou difícil?** 1. ed. São Paulo: Biruta, 2009.
- CONDE, S.J., ISHARA, K.L., NISHIDA, S.M. & DINI, R.E.S. Proposta de CD-Rom sobre comportamento sexual dos animais para a disciplina de Biologia do Ensino Médio. 2003. (last checked 04 april 2012) <[www.unesp.br/prograd/PDFNE2003/Proposta%20de%20CD-ROM.pdf](http://www.unesp.br/prograd/PDFNE2003/Proposta%20de%20CD-ROM.pdf)>.
- DANTAS, M.A.T. & ARAÚJO, M.I.O. Novas tecnologias no ensino de Paleontologia: Cd-rom sobre os fósseis de Sergipe. **Revista Electrónica de Investigación en Educación en Ciencias**, vol. 1, n. 2, pp. 27-38, 2006.
- DANTAS, M.A.T. & DONATO, C.R. Registro de *Lontra longicaudis* (Olfers, 1818) na caverna da Pedra Branca, Maruim, Sergipe, Brasil. **Scientia Plena**, vol. 7, n. 8, p. 1-4. 2011.
- DANTAS, M.A.T. & TORELLO DE MELO, F. Um Conto, uma Caixa e a Paleontologia: uma maneira lúdica de ensinar Ciências a alunos com Deficiência Auditiva. **Revista Electrónica de Investigación en Educación en Ciencias**, vol. 4, n. 1, pp. 51-57, 2009.
- DELIZOICOV, D., ANGOTTI, J.A. & PERNAMBUCO, M.M. **Ensino de ciências fundamentos e métodos**. 4 ed. São Paulo: Cortez, 2011.
- DONATO, C.R. & DANTAS, M.A.T. CD-ROM como instrumento de aprendizagem significativa sobre a Bioespeleologia Sergipana. **Revista Electrónica de Investigación en Educación en Ciencias**, vol. 4, n. 2, pp. 39-47, 2009.
- DONATO, C.R. & RIBEIRO, A.S. Caracterização dos impactos ambientais de cavernas do município de Laranjeiras, Sergipe. **Caminhos de Geografia** - revista online, vol. 12, n. 40, pp. 243-255, 2011.
- DONATO, C.R., RIBEIRO, A.S. & SOUSA-SOUTO, L. Análise ambiental e avaliação da relevancia das cavernas do município de Laranjeiras, Sergipe. **Espeleo-Tema**, vol. 23, n. 2, pp. 59-69, 2012. <[www.cavernas.org.br/espeleo-tema/espeleo-tema\\_v23\\_n2\\_059-069.pdf](http://www.cavernas.org.br/espeleo-tema/espeleo-tema_v23_n2_059-069.pdf)>.

- FERREIRA, A.S. **Elaboração de um livro paradidático sobre os Anfíbios Anuros da Unidade de Conservação Refúgio de Vida Silvestre Mata do Junco, Capela, SE.** 48 p. Undergraduate Thesis: Universidade Federal de Sergipe, São Cristóvão, 2011.
- FERREIRA, A.S., DANTAS, M.A.T. & DONATO, C.R. Ocorrência de *Leptodactylus vastus* Lutz, 1930 (AMPHIBIA-ANURA: LEPTODACTYLIDAE) na caverna Toca da Raposa, Simão Dias, Sergipe. In Proceedings of the 30° Congresso Brasileiro de Espeleologia, Minas Gerais, 2009. <[www.cavernas.org.br/anais30cbe/30cbe\\_057-062.pdf](http://www.cavernas.org.br/anais30cbe/30cbe_057-062.pdf)>.
- FERREIRA, R.L., GOMES, F.T.M.C. & SILVA, M.S. Uso da cartilha “Aventura da vida nas cavernas” como ferramenta de educação nas atividades de turismo em paisagens cársticas. **Pesquisas em Turismo e Paisagens Cársticas**, vol. 1, n. 2, pp. 145-164, 2008. <[www.cavernas.org.br/ptpc/v1\\_n2\\_145-164.pdf](http://www.cavernas.org.br/ptpc/v1_n2_145-164.pdf)>.
- KARNOPP, P.K.F., ANDRETTA, V., MACEDO, R.L.G., VITORINO, M.R., MACEDO, S.B. & VENTURINI, N. Espeleologia: um instrumento de difusão da educação ambiental em atividades ecoturísticas. In Proceedings of the II encontro interdisciplinar de ecoturismo em unidades de conservação/VI Congresso Nacional de Ecoturismo. Itatiaia, Rio de Janeiro, 2007.
- KRASILCHICK, M. **Prática de ensino de biologia.** 4 ed. São Paulo: Editora da Universidade de São Paulo, 2004.
- LINO, C.F. **Cavernas: o fascinante Brasil subterrâneo.** São Paulo: Gaia, 2001.
- MORATO, L. Quicktime Virtual Reality e Estereofotografia: utilizando técnicas fotográficas imersivas para a divulgação da Espeleologia no Brasil. In Proceedings of the 30° Congresso Brasileiro de Espeleologia, Minas Gerais, 2009, pp. 151-158. <[www.cavernas.org.br/anais30cbe/30cbe\\_151-158.pdf](http://www.cavernas.org.br/anais30cbe/30cbe_151-158.pdf)>.
- OLIVEIRA, A.C.M., DANTAS, M.A.T., DONATO, C.R. & VIEIRA, F.S. CD-ROM como ferramenta auxiliar para o estudo dos ecossistemas pelos alunos do 6° ano do Ensino Fundamental. **Educationis**, vol. 1, n. 2, 2013.
- RODRIGUES, B.E.P.F. Espeleologia no ensino fundamental: contribuições da pedagogia waldorf para a educação ambiental e o ecoturismo. In Proceedings of the 29° Congresso Brasileiro de Espeleologia, Minas Gerais, 2007. pp. 121-128. <[www.cavernas.org.br/anais29cbe/29cbe\\_121-128.pdf](http://www.cavernas.org.br/anais29cbe/29cbe_121-128.pdf)>.
- SANTANA, M.E.V., SOUSA-SOUTO, L. & DANTAS, M.A.T. Diversidade de invertebrados cavernícolas na Toca da Raposa (Simão Dias - Sergipe): o papel do recurso alimentar e métodos de amostragem. **Scientia Plena**, vol. 6, n. 12, pp. 1-8, 2010.
- TRINDADE, F.F., DANTAS, M.A.T., DONATO, C.R. & VIEIRA, F.S. Descobrimos as parasitoses: jogo educativo para o Ensino Fundamental. **Educationis**, vol. 1, n. 2, 2013.

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