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Blindness and Fungi Kingdom: A New Approach for Teaching a Biological Theme for Students with Special Visual Needs

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Teaching students that have visual disabilities differ from others as they need other senses to unveil our extremely visual world. Therefore it is necessary to use specific didactical resources for properly teaching these students. In this work we described a tactical didactical material to teach the Fungi Kingdom topic, an important biological theme that involves diseases and biotechnological contents. The material was constructed with parchment paper and others simple materials that can be produced at school or even home. Its main advantage is the simple preparation and low cost, which allows the construction by anyone about any theme. To identify the effectiveness of this didactical material, we performed an evaluation with blind students, which confirmed its potentiality for using on teaching not only this complex topic but other regarding mycology or other biological themes.

Keywords: Blindness; Didactical Material; Fungi Kingdom; Special Needs

Introduction

The issues of social inclusion at schools have been widely discussed in the last decades. On this context, several studies have been performed in Brazil, thereby contributing to the process of inclusion in this country (Ferreira & Glat, 2003; Glat & Fernandes, 2005).

In Brazil, the advances in education of students with special needs had its starting point in the Salamanca Statement (UNESCO, 1994). This document established the right to education for all children, particularly those with special educational needs that should have access to regular schools.

Since 1996, inclusive education is guaranteed in Brazil by the Federal Law (Brazil, 1996) that established the guidelines for national education (LDB). According to this law, it is the duty of the state to guarantee the specialized teaching care for students with special needs (Carneiro, 2007).

Although the inclusion of students with special needs at school can bring many advantages, this law imposed the education for people with special needs in regular school, but did not avoid the teaching and learning exclusion of people needing special care inside the school (Ferreira, 1998).

Despite the benefits, the inclusion of students with special needs should be done with caution as they need proper didactical materials, physical resources and trained professionals to guarantee a real and efficient teaching and learning process (Feltrin, 2007; Maciel, 2000). On that context, an important point is the teacher's formation, since the learning of students who have special needs depends, among other factors, on the teacher's ability to work with them. In Brazil, mostly of the teachers are not prepared to do so as they do not receive instruction during the graduation courses at university (Maciel, Glat, & Nogueira, 2002; Vitaliano, 2007; Gasparetto et al., 2001).

Some proposals to overcome this problem are described in the literature such as the *School of Inclusion*, a Brazilian teaching program recently reported to (in) form teachers and undergraduate and graduate students about producing its own teaching material for people with special need (Delou et al., 2012).

According to Ferreira and Cerqueira (2000), instructional materials are extremely important in educating people with sight problems, as they allow illustrating the schooling topics. They also assist the students in their knowledge construction and concept formation as overcome the gaps left by the simple verbal explanation. They may also provide an extra motivation for learning as they can socially include these students in their school class by integrating them with the current topics on real time.

For the production of any educational material developed to support and attend students with visual impairment, it is necessary to understand how their teaching and learning process is. Otherwise, without the necessary understanding about it, the teaching material can end up not reaching its goal of making learning easier or may even be totally confuse (Batista, 2005; Bruno & Mota, 2001).

Therefore, as the visual effect is not a feasible option, it is necessary to project the enhancement and use of other senses, like touch, hearing, smell, taste, when preparing these didactical materials. It is also important to consider the size, not too big or too small, to assure that overall understanding or important details are not lost. Another important aspect is when using tactile material, not hurting or irritating the student finger's skin, keeping the highest fidelity possible. It should also be simple and with high durability or easy reposition so it can be used without concern (Cerqueira & Ferreira, 2000).

Here in we focused on the elaboration of a didactical material

that address the Fungi kingdom, a topic of the Brazilian High School education. This is a relevant theme to human life as it involves diseases, the damage to agriculture and agribusiness, and use in pharmaceutical and food industry. Our purpose was to create an educational material that eases comprehension of people with visual impairment on fungi topics and their importance in human life.

Methodology

In this work we produced educational material of low cost, easy preparation, high strength, and easy transportation. On that purpose we used parchment paper sheets in A4 format, plus stylets and some special pens called boleador in Brazil. The paper could be found at any stationery and the stylets and pens can be prepared if not found to buy (**Figure 1**).

The selection of parchment paper was due to its feature of not occupying much space, be very light and available in different thickness. Thus it can be easily stored in plastic folders, briefcases, files and drawers, as well as they can be transported from one place to another easily and be used to design any embossed structure. We selected the paper 180 thickness to avoid damage during transportation or a student handling as this thickness provides greater resistance to the material.

The drawings of the fungal structures were made by pressing spherical iron pens of 1, 2, 4 and 7 mm (**Figure 1(A)**) onto the paper. These iron pens can be bought at the stationery or be constructed by gluing or burning a pin into the tip of a common pen (**Figure 1(B)**).

We also used the pin alone to produce holes in the paper drawings to enhance the sensitiveness of the material to the students also giving access to some fungi structural details.

To better systematize the material, we organized it as a book (Atlas) about fungi of medical and/or social interest present in textbooks of the second year of high school. We selected those microorganisms that can be observed under an optical microscope with no possibility of further contact by a blind student.

After making the drawings, we added the names of fungi species and structures as well as a small explanatory text in increased format letters and in Braille (**Figure 2**). We wrote the Braille text by hand-free. All work was conducted over a rubber or foam sheet of A4 size to avoid damaging the material or the physical surface used as support (i.e. table).

The didactical material was further tested to evaluate their efficiency and effectiveness in teaching students with visual impairments. Therefore, this test was conducted with one teacher and two students with total blindness. One student was in the second year of high school whereas the other has just finished it.

All interviewees were recorded and we used four criteria to analyze them based on articles by Christopher & Ferreira (2000)

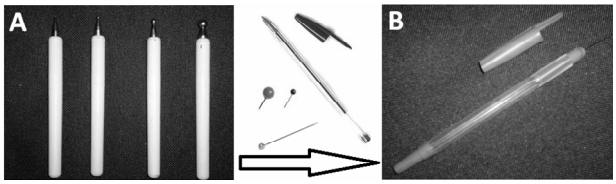

Figure 1.
The iron pens (1, 2, 4 and 7 mm) used to design the figures of the fungus in high thickness. By using pins and common pens we may produce these iron pens or stylets (B) that increase the touch sensitiveness of the drawings.

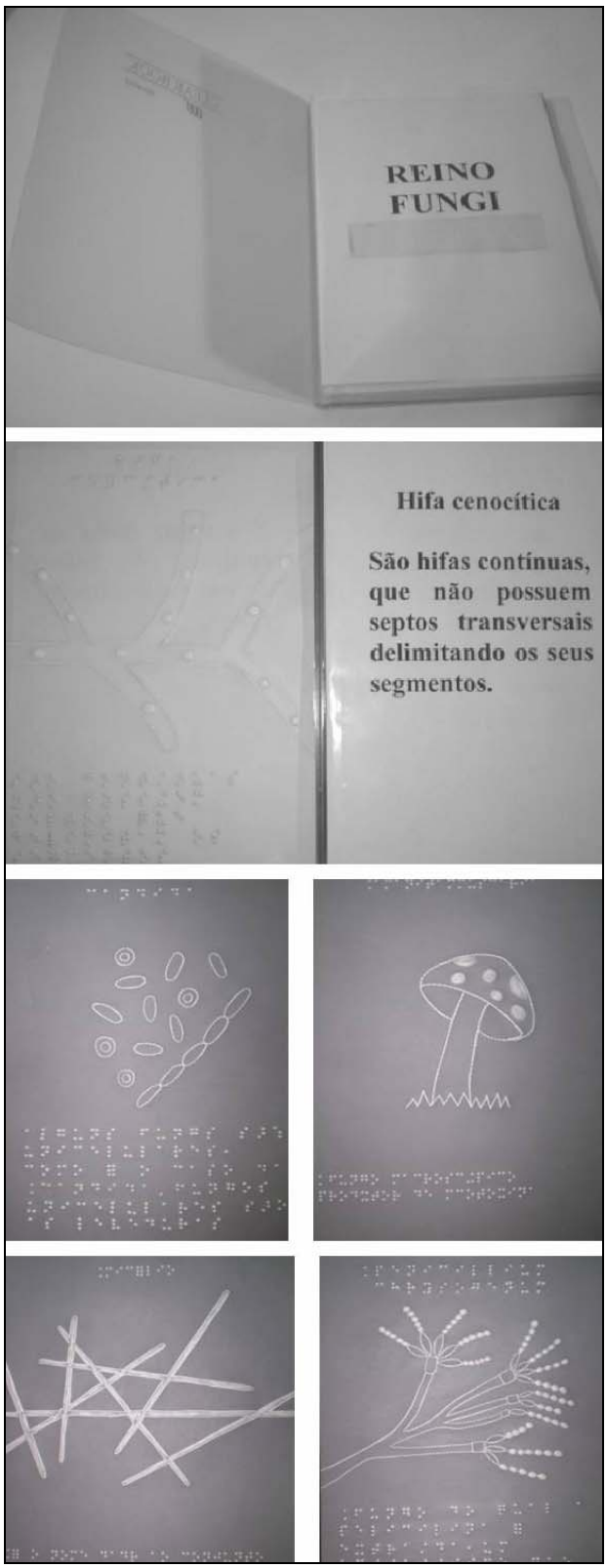

Figure 2.
Atlas of Fungi Kingdom created to help teaching people with special visual needs. The booklet contains embossed drawings of different types of fungus, the explanatory text in Braille for blind students and increased caption size letters for visual impaired students.

and Grifing & Gerber (1996), which included 1) Easiness of using the material; 2) Perception of the fungi structures and understanding of the Braille text; 3) Acceptance level of the material and 4) Material resistance.

Results and Discussion

The University and Its Contribution to the Inclusive Education

Recently, through the Declaration on the Rights of Persons with Disabilities (UN, 2006, Article 24), the United Nations called on countries to provide inclusive education at all levels (Pijl, 2010). To Runswick-Cole (2011), inclusive education is the reduction of barriers to learning and participation of all students, not just those with disabilities.

In recent years in England, according to Hodkinson (2010), education policy has promoted inclusive education as education for disabled and not disabled children within the schools in the same neighborhood; however, the achievement of educational goals has been a great challenge for the country. In this context, universities can play a central role in educational policy. How can the university contribute to inclusive education? According Glat & Pletsch (2004) the universities need to form two types of teachers including those qualified with the minimum of knowledge and practice to work with students in general, covered in undergraduate courses on the whole; and those "*specialized*" in different special educational needs.

Worldwide, the university is the institution responsible for generating knowledge and forming human resources. According to Sigurdardóttir (2010), several European universities carried out programs and projects for the development of inclusion policies aimed at improving the skills of undergraduate students and providing them with knowledge about inclusive education.

Sigurdardóttir reported that in Scotland, the University of Aberdeen develops programs for inclusive education for teachers working with all children, special or not, members of regular classes. Recently, the University of Exeter in England has created an internship program for all prospective teachers who thus develop practical activities with pupils with special educational needs. In doing so, the university led to the development of future teachers' skills, as well as attitudes and understanding of special educational needs. Undoubtedly, these university programs are designed to make prospective teachers more confident about their skills in teaching. In Northern Ireland, the universities have a positive attitude regarding the inclusive practice, strengthening it through the internships of future teachers in schools, where they experience their daily lives and incorporate ideas to support inclusive education.

According to Glat & Pletsch (2004), for the development of inclusive settings, universities have a great contribution to make, especially in the training of teachers in the production of knowledge through research and projects that validate and disseminate successful educational actions.

The blind student has a great development capacity at both social and intellectual level. However, it is necessary that the educational institutions knows how to offer proper teaching and learning access and opportunities (Bruno & Mota, 2001). In case of teaching visually impaired students, the use of educational resources based on other senses such as touch is totally essential.

Herein we described the production of tactical didactical material for teaching blind students. This material was produced by R.S. in our research group during her undergraduate course on biological sciences in a federal university. This effort stimulated the pro-active behavior of this fresh teacher during her graduation. Now she found a feasible way of teaching her blind students and participates in a Program in the university to help on forming other teachers with this perspective.

The Atlas of Fungi Kingdom

The Atlas of Fungi Kingdom is an easy and low-cost didactical material for teaching blind students (**Figure 2**). It could be produced by anyone including regular students that are close to this people or even family member. Therefore they may teachers and special students in the teaching and learning process.

In this work we selected some fungus as subject of this didactical material based on their medical, social and/or environmental relevance. The atlas presents:

1) The hyphae, including those septated with, or without pores;

2) The mycelium (a set of hyphae).

The exemplification of these structures is of great importance since they constitute the basic structure of a fungus and a starting point when approaching mycology. In addition, for illustrating the fungi kingdom for the visually impaired students we also constructed the embossed figures for:

3) *Penicillium chrysogenum*, due to its medical importance as antibiotic source, and also as an example of multi-celled microscopic fungus;

4) The fungi of *Candida* genus, which are not only human commensals that in some cases can cause candidiasis, but also an example of yeast fungus;

5) *Amanita muscaria*, an example of macroscopic fungi that presents hallucinogenic and neurological effects.

Evaluation of the Tactical Material with Blind Subjects

We presented the material separately to three blind subjects including one teacher and two high school students. For each one, we explained the mycology content of the material along with the explanation of the work and our main goals. Then the interviewees evaluated the material and all conversations were recorded.

The Teacher's Opinion

The first test was conducted with a blind teacher who teaches English at a school in Niteroi. According to this teacher the embossed figures where noticeable including the differences among the fungi examples. During the interview the teacher said several times that the material was very well done as she could feel the structures by tactile perception.

The teacher commented about some of the texts in Braille that were prepared by hand-free (without the slate and stylus commonly used by blind people to write it). "… *I can understand but the spacing is wrong*. *The free hand writing of Braille is complicated*; *you should use the slates*…" This revealed the need of using the slates to guarantee the proper reading of the Braille text.

Our biggest concern was about the mushroom (**Figure 2**) as this model is unique among all others as it has three dimensions. Therefore, this question was presented to the teacher, who considered it perceptible and understandable.

At the end of the interview, when asked about if she identi-

fies the clear usefulness of the material pedagogically, the teacher's response was categorical: "*Sure*, *absolutely*!"

The 2nd Grade Student's Opinion—High School Level

The material was also evaluated by a blind sixteen years old boy, who was at second grade of a high school in Niteroi. The material was presented as an individual lesson about the theme Fungi Kingdom.

As the student knowledge about the theme was very small, the class began with the phylum exemplification without using the material, talking about the fungi habitat and their ecological, economic and medical importance. The use of the material started only during the explanation of macroscopic and microscopic fungi, to exemplify these microorganisms.

According to the student the material can be useful in the classroom as he said: "*You have to show it to my biology teacher, you know*? *You have to show it since it is the only way they will have an idea how to teach me*. *Because, please, looks how it is boring*! *the teachers always say—you have to study, must study, must study—but if I do not have anything written or recorded on my computer* (*how to study*?) … *Because I'll put the recorder to record the lesson in class but the voice of my colleagues disturbs a lot and it has been a loss of time and energy*."

To determine whether the blind student is able to identify the fungi structures after class, we exposed the material in a random form to him. Interestingly, the student was able to distinguish all fungal structures represented in each model even when presented out of order.

The Student's Opinion—Complete High School Level

The last interview was performed with a blind student who just finished high school and was attending classes to get into a university. The material was presented as performed for the first student with an initial oral lesson and then the material exposition.

The student showed a great interest in pronunciation and spelling of fungi names and structures. This behavior was related to his necessity of studying for the university exams. This curiosity required greater use of the Braille text. Similar to the teacher's opinion, according to this student, he understood the texts but the reading of Braille prepared with the slates was faster that those hand-free made.

He also examined the structure and size of the embossed drawings, and informed that it was possible to feel and visualize the structures, whose size was adequate. According to the student: "*The material is excellent, does not hurt or irritate and its high tactical property is very useful*. *Can you build a plant cell in the paper for me*? *Because I have a little difficulty with cell as I do not see it*."

The overall analysis of the material in these *locus* tests with the three blind subjects showed that the material attended most of the proposed criteria including easiness on using it, perception of the fungi structures and acceptance of the material. Besides, it did not expose students to risks as hurt, skin irritation or cut during handling (Cerqueira & Ferreira, 2000; Bruno & Mota, 2001). The only issue was the understanding of the Braille text that pointed to the need of using slate and stylus in order to guarantee the fastest access to the text.

Regarding to the material resistance, during the atlas preparation, the strength of the material was considered, so the durability is long. The material composition also allows it to be handling by many students and be redone frequently by anyone. The lifetime of this material could not be defined, but many people have used this material and it has persisted for three years with the same physical characteristics since now.

Conclusion

Both normal sight students and visually impaired students can learn and develop if properly stimulated and attended. In this work, based on the people interviewed about the tactical didactical material produced herein, we detected the necessity of preparing more teaching materials or other forms of guarantee the access of knowledge for students with special needs. We believe that our goal to teach the blind students more clearly was reached and led to the creation of a material that can be employed not only for teaching biological themes but also other topics from other areas and disciplines.

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