PhD (Per hour Doctor): a ludic, interactive, educational activity using microscopy

M. A. Vannier-Santos[1,2*] and E. Deccache-Maia[1,3]

[1]Parasite Cell Biology Laboratory and Electron Microscopy Unit, Instituto Gonçalo Moniz, Fundação Oswaldo Cruz, FIOCRUZ. Rua Waldemar Falcão, 121, Candeal, Salvador, Bahia, Brazil, 40296-710.
[2]Escola Bahiana de Medicina e Saúde Pública FBDC. 3- Pontifícia Universidade Católica, PUC-RJ.

.

The present chapter is meant to present a ludic, interactive and educational activity using light microscopes to simulate parasitological diagnosis in schools or science fairs. The students receive a book with parasite images and 3-6 microscopes display easily identified parasite forms (*e.g. Giardia lamblia* trophozoites or *Ascaris lumbricoides*, *Schistosoma mansoni* and *Trichuris trichiura* ova). The students fill in forms with the pathogen species and disease name and sign it. Well-trained graduate students or researchers act as tutors and assist the kids to accomplish the task. After completion they receive a personalized certificate signed by the tutors. The activity is carried out subsequent to attendance to different science fair activities, such as several videos (mostly videomicroscopy), posters, dealt with parasite resin replicas etc. This game-like educational activity was performed with many hundreds of Brazilian students of diverse ages (primary and secondary schools) and adults which took part very enthusiastically.

Keywords: Microscopy; education; Parasitology; science popularization

1. Microscopy *vs*. the unseen

Telescopes open the window to the big distant corners of the universe whereas the upside down Galileo telescope, the microscope, opens our eyes to the close and fascinating micro- universe.

Since remote times curiosity has driven mankind to search for answers to the so-called mysteries of life. According to Einstein (What I believe, 1930) “The most beautiful experience we can have is the mysterious”. The mystery (covered with mist; unseen) concept is marked and also marks the historical contexts.

For most of human history the visible world comprised the *view* of natural world. This point of *view* is confirmed by Friderich Schelling statement that “Nature is visible spirit, and spirit is invisible nature” (Ideas for a Philosophy of Nature, 1797; *loc*. *cit*. [1]). Despite the scientific and technological advances available in the present, the *Homo sapiens sapiens* tends to disregard what he cannot see. This limitation is usually more frequent in countries such as Brazil with high illiteracy and functional illiteracy levels.
Different kinds of microscopes shed light on the way to some of the most relevant discoveries in science and technology**.** The descriptions of bacteria, sperm among other cells by Anton van Leeuwenhoek, comprise seminal and remarkably important discoveries in the history of science [2] and medicine [3].
After van Leeuwenhoek and Hooke, the images of diverse microorganisms through the rudimentary lens of early XIX century microscopes elucidated the microcosmos causing much wonder as the universe images obtained by the Hubble Space Telescope [1]. Since then microscopes comprised ship-like devices that transported the curious eyes of amateur scientists to the microscopic realms for entertainment. Even today the general public may be amused by the glimpse of the formerly unseen

* Corresponding author: e-mail: vannier@bahia.fiocruz.br or marcos.vannier@pesquisador.cnpq.br;
phone +55-71-33562208

universe, often termed exotic (foreign, alien), but should rather be also called "*inotic*", since many of these creatures dwell within our bodies. These tools in the skilled hands of scientists such as Malpighi, Pasteur, Schwann, Cajal and Chagas, just to mention a few, led to seminal far-reaching discoveries. Two centuries later microscopes still fascinate the public (Fig. 1A), but scientists engaged in *bona fide* academic activity became bright and distant as the stars. In fact, telescopes may be required to observe them too. Unfortunately this distantness hampers the scientist citizenship commitment.

Figure 1: A- Science and Health fair at Camaçari, Bahia (Social Action). Note the attention of the children observing the living creatures in a drop of mud just colleted. B- Bus used by FIOCRUZ team to visit low-income suburban and rural areas.

In the early nineteenth century the forerunner scientists were instrumental in conveying science to the general public as it was a social activity for fun. Science museums nowadays revive the pleasant voyage to knowledge. Therefore FIOCRUZ foundation, sponsored by Secretaria Estadual de Ciência Tecnologia e Inovação da Bahia /FAPESB acquired a bus (Fig. 1B) to visit the Salvador periphery and rural towns in science popularization and public health activities.

Even nowadays microscopes play pivotal roles in biomedical and technological research**.** Handling microscopes and interpreting their images are at the core of the activity of many professionals no matter academic or not.

2. Microscopes as educational tools

There is a limited number of practical activities held is schools to demonstrate the use of microscopes and its relevance in human/animal health, particularly in developing countries.

Many educational institutions employ microscopes simply to demonstrate tissues and cells, including microbial life forms. Most of the time the students passively stare at the microcosms, with no active interaction, as kids observing the stars through a telescope. Nevertheless, microscopes are rather useful in solving scientific problems and are valuable tools in human and animal health. We are convict and here attempt to convince the readers that dynamic educative, interactive activity using microscopes may be more interesting elucidative. Early reports of St. Augustine indicate the relevance of lucidity in the learning process. Challenging, pleasant, educative activities are easily carried out with effective participation and high awareness. There are some well-planned comprehensive microscopy publications for college, graduate students and researchers [*e.g.* 4-9], whereas there are few activities aimed for school students [*e.g.* 10, 11], particularly in a hands-on fashion [10].

The present chapter is aimed to propose an educational interactive game using microscopes with children, teenagers and non-specialized adults.

Microscopes are used not only for scientific purposes but also for diagnostic procedures.

PhD (Per **h**our **D**octor) was designed to stimulate students to explore the microscopical world and acquire basic knowledge on parasitological and public health.

3. PhD (Per hour Doctor) a ludic game-like educational activity

The activity is usually performed in schools as well as other public places, where the group placed announcements stating: "**BECOME A PHD**" (in colors) and the general morphology and biology of the parasites of medical importance were already presented in posters, videos etc.

The activity simulates parasitological diagnostic procedures using fixed stool samples in fixed mounted slides, therefore composing no biological hazard for students. The use of slides employed for diagnostic means, helps in the creation of a realistic atmosphere in here game. The tutors, graduate students in MSc or PhD courses, let the children/ teenagers are led to feel they are really taking part in a diagnostic procedure, dealing with real human samples (from stool examination or laboratory cultures) and the health or very life of "our patient" depends on here precision and reliability of the PhD diagnostic.

Figure 2: Primary and secondary school students compare the parasites in the non-identified slides with the pictures in a specially-made book or atlas (A, B). Note the students seem to enjoy the activity (B). The practice may be successfully performed with kids residing in slums (C- Síntia Sacramento). Skillful MSc (D- Karla Anjos) or Biological Sciences students (E- Daniel Silva and Diego Menezes-right) act as tutors and supervisors, assisting the kids to accomplish the activity.

The game may be performed with 3 to 6 microscopes and played by several students simultaneously, depending on the room conditions and availability of well-trained tutors, which should be a researcher or skillful experienced graduate student.

The microscopes are marked as A, B, C… or 1, 2, 3… (Fig. 2) and the students receive a form to be filled (Fig. 3) in with the numbering or lettering of the microscopes as well as fake names of the patients and blanks for the names of the corresponding disease and/or pathogen. Joking names such as *Will Ill*, *Sean Pain*, *Mick Sick*, *Lady May Die*, *Infec Ted*, *Joe D. Sease*. In Spanish, names such as *Dolores Dolorida*, *Rojo D. Sastre*, *Hernandez Enfermandez* could be used. In Portuguese we used the names: *Enfermildo Nosogênico das Dores*, *Moribundófilo Hipocôndrio Hipocondríaco*, *Patológico Crônico Inácio da Silva* (any slight similarity with the name of a famous politician is unequivocally coincidental). We solely employ quickly and easily identifiable parasites in unambiguous developmental forms such as *Schistosoma mansoni*, *Ascaris lumbricoides*, *Trichuris trichiura* ova or adults, stained *Giardia lamblia* trophozoites. The students are allowed to observe the unidentified slides and compare with the images in a "book-like" compendium or atlas (in fact we often use photograph albums covered so as to resemble a

book or encyclopedia, Fig. 2). The students freely page the books looking for similar images to accomplish the diagnosis. The images are clear, high resolution colored micrographs, often taken from the same slides they are observing, under the very same conditions in order to facilitate parasite identification. The graduate students supervising the activity are recommended to assist the kids as much as possible but to encourage them to take it seriously. As the parasites are identified and filled the blanks the kids are cheered and receive congratulations and compliments. The general idea of the activity is to demonstrate the use of a microscope as an interactive tool to solve a problem and compare its images with the information obtained in printed material. This activity is ludic and in order to be performed the students deal with books and microscopes. It gives them the perception that factual and accurate information maybe obtained from these media.

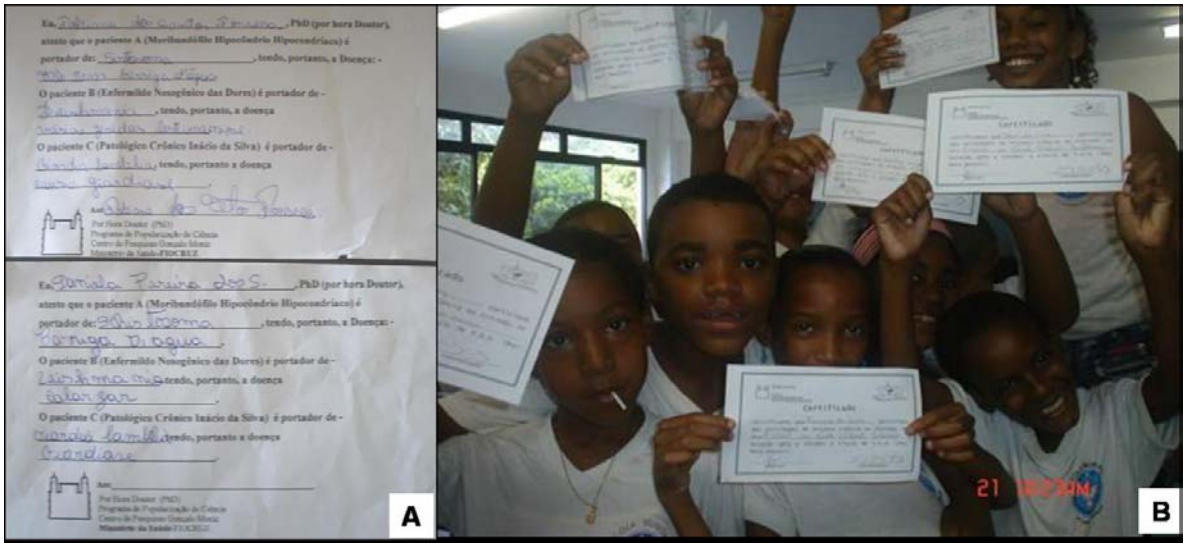

Figure 3: Students fill the form blanks with the parasite species and names of diseases (A) and after completing the practice they receive certificates signed by researcher and tutor-student (B).

Depending on the age of kids they may receive candies as a kind of prize. After activity completion the kids receive a certificate with his name and signed by the researcher and the graduate student (Fig. 3).

4. Concluding remarks

In his classical publication, *Homo ludens*, Huizinga [12] highlights the relevance of lucidity to human society and its serious aspects. The term ludic comes from *ludus*, the Greek word for game, but it is not necessarily aimless. This game-like activity poses profound impact on the students for they understand they are dealing with real diagnostic samples, from real patients. They sense the relevance of the activity, so they feel valued to take part in it. By imagining they may help saving a human life brings a very effective empowerment sensation and self-esteem encouragement, particularly whenever new information is learned.

The school students usually get very pleased to receive such a certificate and they promptly keep it safe with them. Once, a kid lost his certificate, so he rushed apprehensive to us asking for another one. He was clearly relieved after receiving the second copy. The graduate or undergraduate student tutor also is contented for the responsibility of signing and delivering numerous certificates. This reinforces their feeling of citizenship for both student groups. Hundreds of primary and secondary school students excitedly took part in the activity and it was generally rewarding for both students and tutors. Since the activity was successfully performed with kids from slums (*e.g.* Fig. 2 C), usually undergoing poor health

and education conditions, it may be instrumental in health promotion, scientific literacy and ultimately social inclusion.

Acknowledgments: Supported by FIOCRUZ, CNPq, SECTI-FAPESB and CAPES. We are grateful for the valuable help of Adriana L. Rangel, Alene V. Santos, Ana M. Novais, Diego Menezes, Karla G. Anjos, for the competent performance of the PHD activity.

References

[1] L. Gamwell. Exploring the invisible: art, science, and spiritual . Princeton University Press, 2002.
[2] B. J. Ford. The Leeuwenhoek Legacy. Biopress, Bristol, and Farrand Press, London, 1991.
[3] M. Friedman; G. W. Friedland. Medicine's 10 Greatest Discoveries, Yale University (Paperback), 1999.
[4] M. Duvert; P. Thuiébaud; A. Verna; J-L Vernay; N. Thézé. Training of students in microscopy studies of normal and pathological structures: a pratical course. Science, Technology and Education of Microscopy: an Overview Spain, Formatex. 2003.
[5] F. Grizzi,.; B.Franceschini,.;M. Chiriva-Internati,; P.L. Hermonat; G. Shah; P.C. Muzzio; N. Dioguardi. The complexity and the microscopy in the anatomical sciences. Science, Technology and Education of Microscopy: an Overview Spain, Formatex. 2003.
[6] J. De Juan; R.M. Pérez-Cañaveras. How we Teach Recognizing Images in Histology. Science, Technology and Education of Microscopy: an Overview Spain, Formatex. 2003.
[7] D.J. Stokes. Investigating Biological Ultrastructure using Enviromental Scanning Electron Microscopy (ESEM). Science, Technology and Education of Microscopy: an Overview Spain, Formatex. 2003.
[8] M. I. Herrera; A. Vivo; E. P. Pastrana; Y. Santa-Maria; J.A. Fernandez del Campo; L. Cuevas. Strategies of Electron Microscopy in the Diagnosis and Characterisation of Emerging Infections. Science, Technology and Education of Microscopy: an Overview Spain, Formatex. 2003.
[9] Marcos A Vannier-Santos and Ulysses Lins. Cytochemical techniques and energy-filtering transmission electron microscopy applied to the study of parasitic protozoa Biol. Proced. Online 2001;3:8-18. (doi:10.1251/bpo19 - available at: http://www.biologicalprocedures.com/bpo/arts/1/19/m19.pdf)
[10] Payne, B.L., Jones, A.S., Dwarte, D. M. & Ringer, S.P. Microscopy Based Outreach Education Programs Science, Technology and Education of Microscopy: an Overview pp. 764-775.
[11] G. Rosolen,.; S. Gerlach.; J. Maravich. Educational Electron Microscopy over the Internet. Science, Technology and Education of Microscopy: an Overview Spain, Formatex. 2003.
[12] J. Huizinga. *Homo ludens*. Boston, Beacon Press, 1971.