

The surfer wears a suit. A report on the II Symposium on Creativity, Imagination and Interactivity in Science Education

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Received December 1, 2004
Accepted January 10, 2005

The paradisiacal beach town of Armação dos Buzios (Buzios, for short) hosted an unusual meeting of scientists, filmmakers, actors/playwrights, journalists, and students interested in the general topic of science education, sponsored by the Vitae Foundation and the Brazilian National Research Council (CNPq), on October 4-8, 2004.

The organizers, Vivian Rumjanek and Leopoldo de Meis, are both Professors of Biochemistry at the prestigious Department of Medical Biochemistry, Federal University of Rio de Janeiro (UFRJ). Leopoldo is well known not only for his internationally acclaimed contributions to Bioenergetics, but also as a trailblazer in Science Education in Brazil. In addition to dozens of articles and book chapters in biochemistry, he has written popular books both on thermodynamics and on the scientific method, video shows on mitochondria, as well as on muscle contraction, and even a play on the history of science, all destined to foster the curiosity and interest in the subject in both high school students and teachers, a much needed requirement for the improvement of scientific literacy in Brazil. Vivian is an accomplished immunologist and currently one of the main driving forces of the department's activities in science education, which include a division of the graduate school of biochemistry specifically directed at that subject.

Why bother? Despite the significant increase in both the amount and the quality of Brazilian science in the last couple of de-

acades, the Brazilian population still has a poor grasp of science in general. The proportion of Brazilian students that may ever have a chance to talk and listen to science professionals is low, and the opportunities to face a scientific problem 'hands on' are rare. Or, perhaps, one should say that what is rare is finding an opportunity to become aware of what is and how to face a scientific problem, if we accept both the idea that 'every child is a potential scientist' and the possibility that the scientific method is indeed natural, and therefore every human being is bound to use it unconsciously in everyday matters ('Damn, the plumber is on holiday, which way should I turn this ...oops - splash - no, the null hypothesis has been rejected, therefore it must be the other way around...').

Sixteen years ago, De Meis devised a vacation course in which high school students were brought into the Department of Medical Biochemistry to spend a week together with the department's graduate students, given a theme and asked by their tutors to formulate their own questions and answer them by themselves through simple experiments. One result of these biannual events is that students develop a genuine interest in science. Selected boys and girls were offered the chance to become interns in the department's laboratories while still in high school, and several of them entered graduate schools in science after receiving their undergraduate degrees. This is all the more impressive because the attendants are drafted at public

schools in low-income areas of Rio de Janeiro, where social conditions are worse and the need for better education is more pressing than among the upper middle-class and the rich.

A critical problem is the low level of scientific understanding among elementary and high school teachers. Thus, the target population grew to include high school teachers, and currently the activities are split into a 'teachers' week' and a 'students' week'. Since 1988, roughly 3,000 high school students and some 900 of their teachers have attended the vacation courses under the guidance of over 250 graduate students. Six years ago, molecular biologist Paulo Arruda, a Professor of Genetics at the State University of Campinas (Unicamp), started a similar program in his university, with Leopoldo's support and funded by Vitae. The Foundation then invited the groups from UFRJ and Unicamp to disseminate their experience, and as a consequence vacation courses have now spread onto 10 universities in several states in Brazil. Usually, members of a candidate team of organizers get in touch with the founder groups, follow a vacation course, discuss methods and details and organize their own activities starting the following vacation, adapting the form and contents to their specialties and regional characteristics.

Tough break. Rio de Janeiro is rather cosmopolitan when compared with most of Brazil, and Campinas is one of the leading academic and technological centers in the country, but how many high school kids or teachers anywhere else would be willing to volunteer a week of their short vacation to spend 12 hours a day in a research laboratory, only to be challenged to think by themselves of a problem, design a way to test it, carry out an experiment, analyze results, discuss them and reach a conclusion on a general subject that wasn't even their choice? Alas, too many, because after the organizers visit the schools to advertise the course, only a fraction of students and teachers can be

taken in among a large number of applicants. Every now and then the organizers have to either turn down, or give in to their own emotions and accept 14-year-olds soaked in tears because they didn't make it to the course. Thus, the pep talk works all right, mainly because demand for learning opportunities beyond the traditional school system is very high indeed.

The complementary arm of such a course is the production of educational material to overcome the low quality and general neglect of a scientific approach in textbooks and other materials used in Brazilian schools. The story goes that vacation course students started a hitherto unheard of questioning of both their high school science teachers and textbooks, the latter of which are a major part of the problem. De Meis also began, several years ago, to produce various types of materials to help counteract the poor quality of available textbooks and he, as well as other leading scientists such as Paulo Arruda, now bring together science and arts students and professionals to design and produce books and films, an early embryo of, perhaps, a sort of Brazilian 'Discovery Channel', one of Leopoldo's cherished goals.

Human behavior is strongly dependent on motivation, and a pervasive premise among scientists is that beauty is a driving force for science. The French mathematician Henri Poincaré (1854-1912) is quoted as stating that '...the scientist does not study nature because it is useful; he studies it because he delights in it, and he delights in it because it is beautiful...'. This brings together a common goal of both scientists and artists, that is to uncover the beauty of nature. Notwithstanding the scientists' grasp of Science, the Arts are the realm of the artists, and most people think of both as too distinct, opposing or even incompatible. To examine this unwarranted view, the aim of the Buzios symposium was to bring them together to share their experiences, their views of the world, their languages and meth-

ods, with an eye to expanding the scope of science education.

Activities started with a preview of a television campaign, and followed with lectures, an interactive workshop on the language of films, exhibitions of scientific videos, theatrical performances and the presentation of science education projects funded either by the Vitae Foundation or the CNPq.

An unexpected debate was stirred by the preview of the TV campaign designed to enhance the visibility of science, created and sponsored by the *Ciência Hoje* (Science Today) Institute and the Globo Television Network. One of the 30-second TV inserts depicts a beach surfer in his fifties wearing a suit and tie at the beach, while a young oceanographer wears a colorful beach outfit, both walking barefoot on the sand. The idea is to trick people into misidentifying the two characters, and take the audience by surprise when, hopefully, youngsters would be amazed and delighted to find out, only at the very end of the film, that someone tanned like that and wearing such a cool outfit is actually ... a scientist! One of the artists in the audience came forward, rather indignantly, to raise the question 'why the heck does the surfer wear a suit?', only to be followed by a defying actor who challenged the use of untrue images to make a point in advertising, and how inadequate this trick was to promote science as the quest for truth. Within half an hour of the beginning of the meeting, it was quite amusing to hear an accomplished artist bickering about the display of an unreal image that had been enthusiastically approved by the die-hard scientists who run the *Ciência Hoje* Institute.

The lectures covered diverse subjects: Danish science writer Tor Norretranders concentrated on the distinct maps that Science and Art build of nature, to discuss the differences and points of convergence of the two approaches; physicist Luiz Davidovich, from UFRJ, offered a delightful trip across the universe of quantum mechanics, leaving

many biologists in the audience to wonder whether conceding that teletransportation can be formally understood when clearly explained, might not deeply shake the foundations of our beliefs in biology itself; João Calixto, from the Federal University of Santa Catarina, commented on the challenges imposed upon Brazilian pharmacology to grow and help foster the Brazilian pharmaceutical industry; neuroanatomist Roberto Lent, from UFRJ, talked about the emerging subject of Neuroethics, that is the growing concern about the use and misuse of the expanding capabilities of science to interfere with the human brain and mind. The author of this report was invited to talk about Programmed Cell Death, and the challenge to present this subject to a widely heterogeneous audience led me well into the problem of learning the adequate language and means to expose cell biology and medical issues to the general public. Finally, paleontologist Sergio Azevedo, also from UFRJ, reviewed how dinosaurs have been depicted in movies. The talks motivated a flurry of questions and occasionally heated discussions among the audience, and vividly illustrated how widely scientists can get their messages across when carefully weighing their language and means not only to address lay audiences, but also to communicate with their peers from distinct disciplines.

In addition, the president of the science and technology agency FINEP lectured on their role in funding innovation in Brazil, and a roundtable on the management and funding of projects in the area of science education gathered representatives from several funding agencies, such as the president of CAPES, the scientific director of FAPERJ, and a senior officer from BNDES, as well as representatives of the scientific community to discuss ways to establish and improve the funding of such projects.

The workshop 'Moving images and the expansion of senses' was coordinated by Heitor Capuzzo, a professor of cinema at the

Federal University of Minas Gerais, and Dorrit Vibeke Sorensen, a distinguished artist specializing in experimental new media, now a professor at the University of Arizona. The aim of the workshop was to demonstrate various approaches to film and animation, discuss their features and provide scientists with a sample of the many languages available to convey ideas through moving images. The 3-part workshop started with a rather lukewarm first session, but the 2nd and 3rd sessions provided ample opportunity for interaction among the presenters and the audience.

Several videos made by groups dedicated to science education were shown, including a new video on muscular contraction by the de Meis group, to be finished and launched soon after the symposium, a video sample that depicts the mechanisms of gene expression and protein synthesis, collated by the Paulo Arruda group, and a video of the life cycle of the mosquito *Aedes aegypti*, filmed and animated by Genilton Vieira from the Oswaldo Cruz Institute in Rio de Janeiro. The video exhibit was followed by a discussion on the proposal of creating a multi-institutional graduate school to train high-level professionals specialized in the production of materials for science education.

The troupe of Group 'Tá na Rua' (roughly translated as 'out on the streets') has a quarter century history of street performances, and a remarkable experience in taking the theatre to general audiences, bridging the gap between theatrical language and the low educational level that is common in Brazilian inner cities. Their shows consisted of three readings of selected parts of a play, two of which included the participation of various members of the audience. The troupe leader, distinguished actor/playwright Amir Haddad, aptly chose the play 'Galileu Galilei', by Bertold Brecht, which is a particularly successful example of depicting the conflict between progressive thinking and the establishment, originally at a political

level but with clear applications to the quest for taking scientific literacy to a broad audience. Issues such as the use of humor, the role of improvisation, the utility of science and others related to either the performance or the contents of the play were easily conveyed through the shows.

Thus, both cinema and theater were covered in the symposium. Nevertheless, although music was clearly a strong component of nearly all movies and clips shown, there was little room for discussing its role and power in helping both motivate and convey ideas to an audience. For example, in a few cases, I felt that the soundtrack seemed to be either too obvious or inadequate to accompany certain images, but it would help to hear what a professional musician would have to say. Given the quality and variety of Brazilian music, it would be advisable to include the theme as a subject for an upcoming edition of this meeting.

Eight groups sponsored by the Vitae Foundation presented their results of organizing vacation courses inspired on the experience of the de Meis group. Marcus Vale, from the Federal University of Ceará, Diogo Souza and João Batista Rocha, from the Federal Universities of Rio Grande do Sul in Porto Alegre, and of Santa Maria, also in the State of Rio Grande do Sul, and Paulo Beirão from the Federal University of Minas Gerais reported on their two-year experience, and Maria Martha Campos, Cristovam Diniz, Lucymara Lima, and Antonio Pavão, respectively from the Federal Universities of Santa Catarina, Pará, Rio Grande do Norte, and Pernambuco showed the results of their first vacation course. A total of roughly 500 high school students and 120 teachers were enrolled in the courses offered at these 8 universities.

In general, the results of these activities conform to the experience of the de Meis group in Rio de Janeiro. Both high school students and teachers came from low-income areas and were selected among a larger

number of applicants than the courses could accommodate. Following the basic plan, they were provided a general theme, requested to ask specific questions and solve the problems through experimentation and observation, using the resources provided by the host laboratories, which always consisted of simple materials and, when strictly required, the simplest possible equipment such as magnifying lenses and surgical instruments. The courses were based on the organizers' specialties and regional characteristics. For example, in Pernambuco the Chemistry Department offered activities centered on fundamental chemistry, using cooking as a motivation tool, while in Pará the subject was the anatomy of Amazonian animals.

Four other groups sponsored by CNPq also presented their experience. Tania Araujo Jorge, from FIOCRUZ, described a variety of science education activities her group has offered in the last several years. Pedro Persechini, from UFRJ, reported on the Espaço Ciência Viva (Live Science Space), an initiative to take science out to the streets in a similar way as the Tá na Rua group has been doing with theater. Leila Beltrami, from the University of São Paulo Campus of São Carlos, presented their course in the chemistry of proteins. Finally Vania Paschoalin reported on her experience in vacation courses at the Chemistry Institute at UFRJ. In general, these initiatives are directed at a similar audience as the projects supported by the Vitae Foundation.

Follow-up of the students and teachers enrolled in the courses was reported to show progress, as expected from the original de Meis experience. Some students were likewise selected for internship in research laboratories, although it is too early to predict

their progress in a science-based career. A major question that was raised in the discussion refers to the limited number of students and teachers that are admitted to these vacation courses. The question is: How to extend the benefits of such exposure to science to a wider target population? How to reach an appropriately large number of students and teachers, to overcome the widespread scientific illiteracy in a country as large as Brazil? One idea that was conveyed in several interventions is that of directing the vacation courses at students of the University's teachers training courses, which will soon be teaching in schools and therefore provide the much needed amplification of science education to large numbers of high school kids. In addition, the dissemination of video and graphic material related to science through the mass media would certainly add power to the task of educating the general public for science matters in an attractive way.

In summary, the week appeared too short for the expanded universe that sprang out of the mutual exposure of scientists and artists. The scientists' dark suits and the artists' colorful outfits (...or was it the other way around?) mixed together in an enticing environment, and we all came back with the feeling that there is a lot in each other's world to be exchanged. This may be of great benefit to both our endeavors, because not only techniques and languages, but ways of thinking may find their way across and into each other's field. After all, if modern science can accommodate quantum mechanics together with overtly materialistic anatomy, we have a lot to gain from the recognition that science and art are perfectly compatible, once we learn how to trade our experiences without prejudice.