Challenges in science communication in the internet: the INCTTOX case

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Abstract

The National Institute of Science and Technology in Toxins (INCTTOX) is a research institute connected to the Brazilian federal government. INCTTOX is dedicated to studying the quantitative and qualitative actions of toxins, bioprospection, innate or acquired immunity and resistance, poisoning processes and therapeutic response. The Institute has developed a few initiatives to promote science online by means of online applications. One of the challenges pertaining to the production of these materials is the development of mechanisms to evaluate their quality and impact before the target audience (Marandino, 2013). In the present work, we are going to give prominence to the development and ongoing analysis of three education applications: Biomemo, ConectCiência and Dortox (www.cienciaemrede.com.br/aplicativos), which can be used

and evaluated by users through an online questionnaire. The form aims at characterizing user's profile, as well as getting to know their opinion about the application and in which context and with what objectives they were used.

Introduction

Increasingly science has been requested and considered by the general public, and likewise, scientists have, albeit to a lesser degree, resorted to and considered the general public in their research. Far from ending the tensions inherent to such trends, science education and science communication appear as fundamental mechanisms to bring together experts and various audiences. Thus, science education, long considered preferably restricted to the school environment, is now also prioritized in other educational settings such as in museums and science centers, cultural centers, NGOs and science fairs. Joining forces with such expansion are the changes in scientific communication in recent years, offering more participatory models, in which one tries to break with the traditional Deficit Model used in most of our communication actions. This project is part of such framework, as it aims to improve science literacy through educational actions and scientific communication developed within The National Institute of Science and Technology in Toxins (INCTTOX).

INCTTOX is one of 157 national institutes of Brazil formed in 2009 by the federal government with the aim of forming networks of leading edge research in some strategic fields of knowledge. INCTTOX is set on quantitative and qualitative studies actions of toxins, bioprospection, innate or acquired immunity and resistance, poisoning process and therapeutic response. Through its first four years, the Institute sought to consolidate and expand groups of scientific capabilities / recognized professors, as well as to contemplate innovation and development of products and processes.

One of the actions of the Institute's *Núcleo de Comunicação* (Center for Communication) was to create the website *Ciência em Rede* <www.cienciaemrede.com.br>, focused on the school audience and the general public. *Ciência em Rede* has been established, primarily, as a means of communication with the general public, where marketing materials produced by INCTTOX is presented.

As one of the unfolding consequences of *Ciência em Rede*, an online channel for Educational Applications was developed (available at www.cienciaemrede.com.br/aplicativos). So far, three applications were published: Biomemo, ConectCiência and Dortox, although having quite different designs, hold as common goal the collection, among the audiences, of social aspects of the construction of scientific knowledge. In this article, we summarize the evaluation process of these applications, after presenting them.

Biomemo online

The printed version of Biomemo was produced in partnership between the Núcleo de Educação do Museu Biológico do Instituto Butantan and the Grupo de Estudo e Pesquisa em Educação Não-Formal e Divulgação em Ciência (GEENF) (Education Center for the Biological Museum at the Butantan Institute and the Study and Research Group in Non-Formal Education and Communication in Science - GEENF) . In the given game, the concept of biodiversity is considered in a broad sense: it includes not only the species richness at a certain site and its distribution but also human being perception as transforming agent of the environment. This approach attempts to include the biological and / or evolutionary aspects, as well as those related to socioeconomic, aesthetic and conservation elements present in different definitions of biodiversity. The game aims to provide better understanding that living organisms and the environment may be represented by humans in many diverse ways through the visual arts. This is a game of association formed by three cards on the same organism, but consists of three different images. Thus, it aims at bringing on a challenge to the memory, the attention and concentration power of players. The online version followed the same goals and parameters.

ConectCiência online

ConectCiência online is based on a print version of the game. Its purpose is to promote reflection on the process of scientific knowledge production, showing images that reveal the diversity of spaces, forms and actors involved in the social production of scientific knowledge. The purpose of this set of images is to promote reflection on the complexity of scientific culture which embraces not only the internal procedures of knowledge production - such as the use of methods, the formulation of theories, consensus building, dissemination among peers and communication to other audiences – but also external elements to the context of science production - as funding policies, impact on society and audience participation (Contier, 2009). Photos included in the material were selected from the collections of the projects participating in INCTTOX. Some of them were created by high school students in educational activities of the Programa de Formação de Divulgadores da Ciência/INCTTOX (Training Program for Science Communicators / INCTTOX).

Dortox

Developed by the Núcleo de Comunicação do INCTTOX, (Center for Communication INCTTOX), Dortox aims to foster increased understanding of scientific knowledge production with emphasis on social interferences in the different phases of the process. With that in mind, we rely on research that is currently being developed by scientists from the Butantan Institute / INCTTOX since the 90s related to the development of drugs for pain relief. The research is on crotalphine, a substance obtained from rattlesnake venom. At this research stage, the group, along with a consortium of pharmaceutical companies, aims to develop a drug for analgesia. Dortox makes it possible to experience different situations, challenges and barriers that scientists are subject to when developing their research study. In order to complete the challenge, users must go through different stages of the research: Bioprospection; Bibliographical Research; Venom purification; Tests of biological activity; Summary of crotalphine; Drug development; Preclinical tests, Clinical tests.
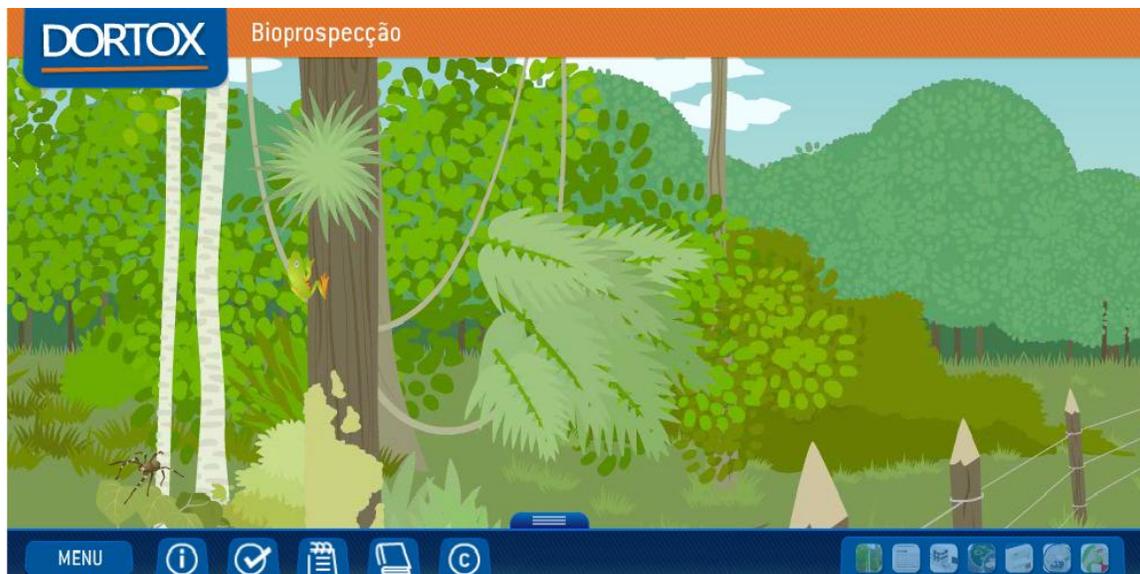
Methodology

For the evaluation of the applications the following has been used as a methodological reference: procedures applied in the analysis of exhibitions and exhibition objects, efficient in the improvement for means of communication to various audiences (Marandino et al, 2009). In particular, we rely on the work of Cury (2006) who proposes six types of evaluation of exhibitions and exhibition material: Conceptual, Formative, Corrective, Summative, Technical and Process Evaluations.

The review of applications focused on three stages: Corrective Evaluation, with almost immediate modifications of unsatisfactory elements of the applications; Technical Evaluation - hereby called usability / playability; and Summative Evaluation, which aimed to analyze the impact on the use of these applications including an investigation into user profile.

Stage 1: Corrective Evaluation

During production of applications, prototypes were created and tested by different INCTTOX participants, including educators and specialists. Modifications deemed necessary were immediately executed through ongoing dialogue with the design and programming teams.

Stage 2: Technical or Playability Evaluation

This evaluation stage was made by a group of undergraduate students previously selected to test playability of applications, guided by questions from the INCTTOX team, as they became available.

Stage 3: Summative Evaluation - Profile of audience and impact

Such evaluation aimed to learn about profile and motivations of those who checked these applications. That way, we have provided an online form to be answered at the end of the interaction. This evaluation stage was held between May and December 2012, with Biomemo and ConectCiência (Dortox was still in the development phase). Responses to the online survey were voluntary, which may explain low number of responses in this stage (25). We chose to not have user register in order to not limit access.

At this stage of evaluation, we also aim to check the way ConectCiência and Dortox could raise public awareness in terms of social aspects of science. For each application, a tool was designed and a methodology applied for evaluation.

For ConectCiência, this third stage of evaluation aimed to map the choices of images related to each of the themes (History, Controversies, Society and Research) made by users of the software. To this end, we developed a visualization interface of these choices, stored in a database. Mapping the correlation of the axes with the images had already been the intent even for the actual physical game, but it was the online version that allowed this automatic storage of the choices.

As it was published later on, Dortox was not included in the evaluation form of audience profile. We chose to draft an evaluation that could already subsidize audience perception for social aspects of science through an online form to be completed by undergraduate students after the completion of the application.

Results and Discussion

Regarding the playability evaluation, only two aspects of Biomemo were changed: the exposure time of the cards was increased and some language adjustments were made on the texts. On ConectCiência we chose to include an explanatory paragraph

for each axis, since the online activity does not have human mediation, and without such pieces of information, parameters for the choices would be missing. The form of presentation of the results was also changed. Before, it was presented only with the total percentage of combinations for choice of images. After this evaluation, we chose to separate this percentage by theme axis, allowing users to compare their choice in each of the axis: research, society, controversy and history.

After evaluating Dortox, some adjustments were made regarding the functionality of the navigation screens, the language in the texts and the understanding of biochemical processes addressed in the application, such as inclusion, as highlighted, of the sequence of the proteins in the protein Synthesis screen.

The technical evaluation was preceded by a corrective evaluation, involving educators and experts at INCTTOX. This evaluative stage, which extended to other points in the production of applications, was critical to the conceptual fit and better negotiation among the educational team, experts and technical development team.

Regarding the profile of the audience of Biomemo and Conectciência, we observed that 29% of respondents were students and 21% elementary school teachers. On motivation of use, 65% said they accessed the applications out of curiosity and 25% as personal entertainment. Access was made possible through communication on the website itself "Ciência em Rede" (25%) and in Education Courses for teachers (25%).

At the end of the questionnaires, users were asked to describe in a paragraph what they thought about the applications. Find below a few transcribed testimonials:

"Biomemo is interesting for students who are starting to make a connection between interconnected photos, while Conectciências, I see as an activity that is built like an interesting mind map to check students' perceptions about what is being addressed." **(testimonial 15)**

"The prospect of demonstrating science as a social and dependent construction of acceptance by others is well represented in the comparison with the percentage of people who share the same understanding of images. Very creative and interesting." **(testimonial 19)**

"I consider important to use ICTs for better understanding of science, especially for the new generation. I congratulate such action and may other applications come." **(testimonial 24)**

Still in relation to summative evaluation, we analyzed the choices of images of ConectCiência in 105 games. According to the record of these choices, we can draw some inferences:

In History, there is strong inclination to choosing images that are black and white, with percentage of choice around 70%. That is an expected pattern, since black and white images, regardless of its content, may emphasize its temporality.

In Society, we can see inclination in choosing images with people in educational settings (travel, museum visits), as well as images of local people.

In Research, laboratory images were chosen, but also with similar frequency, images of computers and articles, which can show a questioning on the classical view of the scientist and on making science restricted to the science lab.

In Controversies, images that contain animals come up more frequently, either animals being manipulated in research scenarios and animal facilities, or dead on the road. Interestingly, that in this category, very similar images of a researcher handling a snake to extract venom or a mouse have different percentages, 15% and 42%. That may show that handling mammals generates more uncomfortable feeling among the audience than a serpent. In this axis, we can also highlight the presence of images showing the interference of people in the natural environment such as road construction.

We can still draw more general inferences. The fact that some images are chosen less may be related to its complexity and difficulty of immediate interpretation, as the images that clearly could fit into more than one category. Some examples are packages of vaccines and the herpetology collection, chosen only in 65% of games while twelve other images appear in more than 80% of the games. For more assertive conclusions following this rationale, we would have to go through another evaluation sequence with that specific goal.

The invitation to answer the questionnaire on Dortox was given to 23 undergraduate students in the field of biology who used the application and evaluated it. Regarding the purpose of the application, 55 % of respondents said that the aim was to

'produce a medication' while 30 % said 'develop a research study'. The percentage shows closer link to the application's most immediate goal, while the development of a research study can be considered the overall goal. When asked about the adequacy of the education context, responses show a homogeneous distribution among contexts (High school, undergraduate in the fields of biology, general undergraduate and non-formal education). This distribution may show the difficulty to classify them. According to respondents, the main difficulty of use is related to the complexity of the content (57%), followed by low motivation level (14%). In contrast, 65% considered the application to be interesting/ exciting, while only 12% considered it boring/ tedious.

At the end of the questionnaire, respondents were able to make general comments on the application confirming the issues raised in the other questions:

"Experiencing the challenges of doing science in an accessible and entertaining way" **(testimonial 8)**

"Interesting because it highlights the steps of scientific research and its difficulties and also the use of

biological material." **(testimonial 12)**

"Dortox is a good application, but also very specific to certain audience (Biosciences students." (testimonial 15)

Conclusion

Despite online tools such as game and applications, having recognized impact with young people, discussing social aspects of science with these instruments still come as a big challenge. That way, having them go through a process of evaluation with the audience is key in improving these tools, both in terms of playability and motivation when compared to how to address the content. The evaluation should be done in a systematic and consistent manner with the engagement of the various audiences and

professionals with different expertise, to reach the expected communication and education goal.

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