

Forensic chemistry: an interactive learning environment

Michelle Camara Pizzato

Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Sul –
Campus Porto Alegre
michelle.pizzato@poa.ifrs.edu.br

Rudá de Souza Roveda

Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Sul –
Campus Porto Alegre
rovedars@gmail.com

Patrik de Souza Rocha

Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Sul –
Campus Porto Alegre
patrikciano@gmail.com

Lediane Chagas Marques

Instituto Federal de Educação, Ciência e Tecnologia do Rio Grande do Sul –
Campus Porto Alegre
ledianemarques@gmail.com

Abstract

This paper aims to present the development of a project that explores the forensic chemistry and criminal investigation for the popularization of science. This proposal includes problem solving, learning and application of experimental techniques and teamwork as strategies for the development of inquiry skills and science communication.

In this regard, the activities were inspired in Role Playing Games, and planned to offer problem-situations and resources (bibliographic, experimental and technological) to participants so that they can, by interacting with these resources, express their ideas in order to solve the proposed problem. Specifically, we proposed activities around the reconstitution of a fictional crime scene and laboratory analysis, which allowed individuals to sort data, run tests, analyze the chemical composition of forensic evidence, and to determine the importance and significance of testing. Research findings suggested the development of inquiry skills associated with observation, description, interpretation, recognition of scientific concepts, problem solving and communication.

Introduction

This paper aims to present a project entitled "Forensic Chemistry - Interactive Learning Environment", which occurs as an university extension activity on the Federal Institute of Education, Science and Technology of Rio Grande do Sul – *Campus* Porto Alegre (Porto Alegre, RS. Brazil). The development of cross-cutting issues such as forensic chemistry and criminal investigation in this paper emerged as a proposal to assist the popularization of science, the construction of a more systematic and contextualized knowledge (Sebastiany et al., 2013; Fiedler-Ferrara and Mattos, 2002), and the development of inquiry skills. In addition, Forensic Chemistry and Criminalistic investigation were chosen as themes of this project, because they are subjects rarely approached in formal and informal teaching, but with great interest in general public.

In this project, we understand inquiry skill or investigative attitude as a relational behavior (Maturana, 2002) associated with curiosity which can be identified through some others behaviors such as formulating questions and hypotheses, data collection, procedures or proposition strategies for problem solving, problem identification, among others. The inquiry skills are essential to the act of knowing, since this requires a curious presence of the subject in the face of the world (Freire, 1983). Therefore, it is necessary that the subjects live learning situations that encourage investigative attitude. Such situations can be experienced not only in teaching, but also through informal education. After all, there are various studies that can confirm that learning science and mathematics

is a long and complex process that does not end at the time of enrollment or within the walls of the school (Rodrigues and Martins, 2005).

The inquiry skills must be the base to form the learning at the scientific area, but have been left in the background, over a teaching disconnected of the reality from students and structured in an expositive perspective. All this factors has caused indifference of the students to science. It is the point of start of this project Forensic Chemistry: Interactive Learning Environment. Working with Forensic Chemistry as basilar and motivated theme in an informal teaching space, students are invited to unveil fictitious crimes moving out their knowledge to solve problems (Tomcho et al., 2008; Kuhn and Pease, 2008; Hu and Hsieh, 2006). Thus, it seeks to develop a non-fragmented idea of knowledge, expanding the range of phenomena of everyday social life, in which decision-making that are grounded in the experiences. It is intended that the participant is placed in situations that allow to recognize the importance of collective work, and individual research.

Methodology

This possibility of interactive learning is based in a structural dynamic of games called RPG - Role Play game, meaning game of character's interpretation - (Duveen and Solomon, 1994; Cronin-Jones, 2000) when the players take on an identity in a plot and scenery defined by the game to complete an adventure research. Under these circumstances they "live" a history and have the opportunity to take decisions and to make choices freely. As an Interactive Learning Environment (ILE), the "Forensic Chemistry" is a space planned to offer problems-situations and means (bibliographic, experimental and technologic) to the participants, so that they can, at the moment of interaction with these means, express their ideas directly to the target: resolve the problem presented. It is noteworthy that the activities were guided by the Investigative Educational Model (Porlán, 1993) proposing research as a methodology and as an alternative to passive teaching methods.

Specifically, we produced two environments - a fictitious crime scene (Figure 1) and an analysis laboratory (Figure 2) – and a set of activities that allow the students for search to evidences, collect samples, analyse and evaluate clues and realize experiments. The project involved the implementation of the following methodological steps: to build

an Instructional Design oriented by investigative learning using the strategy of Role Playing Game (RPG), and the Criminal Investigation and Forensic Chemistry as themes; to develop the ILE, consisting of two physical scenarios - a “crime scene”, containing clues to solve this crime, and a “forensic laboratory”, with materials and equipments required for the resolution of the case; to implement the ILE as a university extension activity; and to test and evaluate the ILE developed.



Figure 1



Figure 2

Results and Discussion

Since its inception in 2012, the environment was visited by over 500 people, including students of elementary and high school, and teachers of Basic Education. Each visit lasts an average of four hours, and the space has a capacity of twenty participants per visit.

During the oriented visit to the ILE “Forensic Chemistry” are presented this steps: reception of the students; presentation of the problem/crime to be solve; learning some techniques of forensic investigation (analysis of fibers, analysis of soil, colorimetric test of narcotics and detection of fingerprints – Figure 3); investigation and collect of traces at the “crime scene”; analysis of the traces and testimonials of the characters involved; discussion with the group about possible hypothesis; denouement and final discussion. Important announce that during all the investigative process realized by students, the members of the project team act only as orienteers and mediators, allowing the visitors are the real investigators, make questions, formulating hypotheses and making deductions.



Figure 3

The techniques of collecting and analyzing evidence used in the ILE were chosen because they are easy to replicate in schools. Some of them are:

- a) **TECHNIQUE OF POWDER:** since the most commonly used among experts, is used when the prints are located in areas that allow the decal printing, or smooth, rough and non-adsorbing non surfaces. At the Environment, use graphite powders (light areas) and aluminum (dark surfaces), and soft bristle brushes purchased from stationers.
- b) **TECHNIQUE OF SILVER NITRATE:** the Silver Nitrate, when sprayed on a surface containing a fingerprint, reacts with chlorides skin secretions, with a result of the revelation of grayish color when exposed to light. After

processing, the print must be photographed immediately because very often the reaction ends up filling the empty area between the papillary ridges, and thus forms a blur.

- c) **TECHNIQUE OF IODINE:** its vapor is brownish and when contact printing, forms a yellowish brown color product. The vapor interacts with printing via a physical adsorption, with no chemical reaction. One advantage this technique has over the others, as the powder is that it can be used before others.
- d) **ANALYSIS OF FIBERS:** natural and synthetic fibers can be differentiated from each other by a simple procedure combustion. Natural fibers (cotton, wool, silk) burn evenly, releasing characteristic odors and leaving a powdered residue. Already synthetic fibers burn sharply, going through a process of melting and leaving a solid residue that resembles melted plastic.

During each visit, the project team monitors the behaviors of participants, recording video in their actions throughout all activities. Our research findings suggested the development of inquiry skills associated with observation, description, interpretation, recognition of scientific concepts, problem solving and communication. In addition, we identified behaviors related to scientific attitudes such as objectivity, parsimony, enthusiasm for research, skepticism, creativity and persuasiveness. On the other hand, have not been identified behaviors related to ambiguity tolerance.

Conclusion

This type of activity stimulates a variety of attitudes: from observation to manipulation, curiosity to question the rationale of experimentation, the right to trial and error, related to communication skills, job analysis and synthesis and creativity. The combination of these attitudes formed an essential part of the individual development. In addition, we believe that the involvement of forensic chemistry, sparse approach in the conventional school context, can come to broaden the range of activities offered in formal learning. Finally, this issue can provide the stimulus to curiosity, creativity and the search for scientific and technological careers.

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