Abstract

Official reports have demonstrated that the number of work-related deaths due to accidents or illnesses is increasing. As such, training programs are currently an important strategy in preventing and minimizing occupational risks. To evaluate the results and effect of biosafety training at the Oswaldo Cruz Institute, Oswaldo Cruz Foundation, Rio de Janeiro, Brazil, a qualitative research with the students of the Biosafety Course in Biomedical Research Laboratories, during the period 2006-2008, based on the Evaluating Training Program by Donald Kirpatrick, covering all levels of reaction, learning, behavior and results. We verified that 54.03 per cent of the students considered the course as excellent, with a 20 per cent increase in the averages of pre and post-tests. The trained students adopted a prevention behavior, making use of individual protection equipment and demanded that the laboratories have the appropriate physical adaptation. The interventions were wide-reaching and inclusive, establishing new criteria for coexistence. As a result of the training, individuals were able to identify and understand the elements of regulations that focused on environmental sustainability and collective health. We perceived that organizational learning is possible adding three assumptions, conceptual, practical and ethical.

Keywords: Biosafety; Professional training; educational evaluation.
Introduction

In our daily lives, we constantly face news referring to the risks that determinate technologies, in the form of products and industrial processes, can cause to our health and environment\(^1\). These are risks inherent to the very processes of modernization, having latent and secondary effects which are as difficult to foresee as they are to warn about\(^2, 3, 4\).

According to Cardoso et al\(^5\) nowadays the proximity of risks is no longer measured, especially biological risks, by physical distance. Giddens\(^6\) also agreed that risks are not limited spatially (as frequently they surpass national borders) or even temporally (being that future generations can be affected). For Gondim\(^7\) it is necessary to initially recognize the context in which the risk is inserted, to aggregate multiple competencies to confront it, because, when the individual meets a determinate danger, principally that coming from the workplace responds in accordance with his beliefs, experiences, images and information constructed throughout his life\(^8\). Even the professionals in the health area who are exposed, overall, to the so-called occupational pathologies\(^9\) react in this way, and tend to follow the culture of doing that which is the easiest rather than that which is most correct\(^10\).

Risk management is the core of the discussion of health promotion, which seeks to orient intervention strategies, such as community training, so that the community itself can participate in actions that improve quality of life\(^11\). It is necessary to recognize the problem (what it is and where, its magnitude, who will it affect and when), either from a scientific point of view or through the perception of those affected\(^7\).

Concerned with these questions, the Oswaldo Cruz Institute (IOC), the largest scientific-technical unit at the Oswaldo Cruz Foundation (Fiocruz), active in the research area, technological development, innovation and the rendering of services with relation to diagnoses of infectious and genetic diseases and the control of vectors, sought to intervene in the workplace so as to prevent and minimize the risks through a Professional Training Program in Biosafety (PTPB). Since 2006, a course in Biosafety in Biomedical Research Laboratories is offered, the objective of which is to constitute a network of institutional commitment – with the managers, students, technicians and researchers – where a standard of behavior is based with the purpose of ensuring the safety of professionals, the quality of research and product results, as well as respect for the environment\(^12\).

The course of Biosafety in Biomedical Research Laboratories has a modular structure – introductory, biological, chemical and physical risks, quality management and animal experimentation – generally offered from March to December, a total of 180 hours, with a dynamic (part-time) schedule that allows it to be concurrent to work activities.

The objective of this study was to evaluate the results of this training program and know its effect on the institution, so as to determine if the interventions were punctual, centered on activities and on the relationships developed in the classroom. Or, if they were more wide-reaching, establishing new criteria for coexistence, with collective spaces for reflection in which there are resources and the force to put the proposals into practice.

Methods

A qualitative study was realized with 315 professionals that participated in the course of Biosafety in Biomedical Research Laboratories, at the Oswaldo Cruz Institute, in the city of Rio de Janeiro, Brazil, in the period of 2006-2008. The evaluation of training in biosafety was realized using the Evaluating Training Program by Donald Kirpatrick\(^13\), divided in four levels:
(a) reaction that aims to measure the student’s impressions of the course. To achieve this, questionnaires were given at the end of each module on which the student could evaluate the professor, the installations and the didactic material, etc.; (b) learning which sought to verify whether the participants increased their knowledge, the results of the pre and post-tests applied and the seminars were used in this phase of the research; (c) behavior, in other words, if the trained professionals are transferring new knowledge and skills to work; and (d) results, the objective of which is to determine the effect of the course on the organization. To evaluate the levels of behavior and results 15 students and their respective leaders were interviewed (5 from each year).

The study was submitted to the Ethics Research Committee (ERC) of the Oswaldo Cruz Foundation, and approved through n°455/08 of 08/19/2008 and all of the subjects that collaborated signed a Term of Consent.

Results
Relative to the reaction evaluation, during the period from 2006-2008, 937 questionnaires were computed (60 per cent of the professionals voluntarily answered the questionnaire) and the criteria for evaluation were scored as excellent for 54.03 per cent of the trained professionals, good for 39.59 per cent and 6.38 per cent regular14. Introductory module was the most praised and physical risk module the most criticized. The availability of books, such as instructional material and the course format (modular structure) were the highlighted positive aspects in accordance with the testimony of student EA0207:

“The structure of the course for me was logical. It was as if each module gave you the experience necessary to absorb the knowledge for the next module. One served as a subsidy for the other, for example, one of the modules that I had was on quality. For me it would be impossible to have quality at the beginning without first having passed through the introductory”.

Regarding the evaluation of learning, it was possible to identify, in the studied period, that there was a 10 per cent increase in the pre and post-test averages. The physical risk module showed the least increase percentual14. Having seminars was helpful in fixing the covered material, stimulating a more critical evaluation of the work environment and generating, in some cases, corrective action or actions which confirmed the applicability of the given classes.

Relative to the evaluation of behavior, in the interviews with the students we verified that all were able to put into practice part of the learned content, 80 per cent mentioned an alteration of the procedures and routines in a more global character, demanding acquisitions of emergency showers and eye-washes, the installation of a sink at the laboratory entrance to wash hands, etc. The other 20 per cent mentioned changes of a more personal nature, such as student EA0208:

“After the course I began wearing closed shoes, hair tied-back, these things linked more to my personal behavior”.

In the opinion of leader EC0109 this difference in behavior resulting in changes of a more personal or global nature is more conditioned to the professional formation and experience of each one. He continues:

“Different professionals with different profiles from our laboratory have already taken this course. For example, we have one person with a technical formation, while another had more experience with teaching, and little experience on the bench, while yet a third, with a profile more in research. Therefore, the suggestions presented by each were also quite varied,
some modifications in the process, such as the discarding of chemical products. Others were relative to the laboratory structure, a bench that has a determinate specification and is not in accordance with the norms”.

Only 13.34 per cent of the students interviewed said that they had no difficulty in implanting the procedures learned in the course. Student EA0508 explained:

“As everybody in my lab has taken the course, we were able to slowly improve all the procedures”.

Relative to the knowledge learned, but not applied, the other 86.66 per cent emphasized the need for institutional actions; actions where resources, processes and relations are worked on simultaneous to training. Although, the Oswaldo Cruz Institute has done an investment to improve its laboratories, infrastructure was cited as being fundamental to the application of the knowledge learned just as much by the students (53.33 per cent) as by the leaders (88.88 per cent). About this, there was emphasis on the importance of segregating the area by the activities developed so as to avoid cross contamination, as well as the specific and appropriate locations to store chemical products and to purchase ergonomic furniture, or even, benches with the kind of covering that permit correct cleaning and sterilizing.

Student EA0606 adds:

“I think that biosafety management is a very long process. It has to be set up on a day-to-day basis, and constantly evaluated. It is a laborious slow process that involves a set of things that do not depend exclusively on the laboratory”.

The non-availability or even the lack of maintenance of collective protection equipment (CPE1) were the justifications presented by 26.66 per cent of the students for the non-applicability of the learned knowledge. Student EA0506 explained:

“We should have CPE1, and maintain it balanced and certified. This policy effectively influences professional safety”.

Questions related to institutional culture were also emphasized, 60 per cent of the students interviewed related that when they returned to the laboratory they were motivated to implant what they had learned, however they met with resistance from those who had not yet participated in the training or even the older employees. Student EA0108 explained:

“We have a necropsy technician, an older one, that didn’t want to wear gloves. And his medical coat had short sleeves. We were able to get him to wear the proper vestment when using chemicals”.

Student EA0407 clarified:

“There is a certain resistance from the people who have been there for more than 10 years. It is a cultural problem”.

1 Collective protection equipment (CPE) has the function of protecting the environment and keep health, besides the integrity of the occupants of certain area, they may be used routinely as biological safety cabins or in special emergency situations such as fire extinguishers.
The role of the leader, as a determinant condition for the changes to occur\textsuperscript{15}, was pointed in numerous other testimonies throughout the interviews. None of the leaders was described as “reactive”, prohibiting a change, or even “discouraging”, who with his negative example makes it truly impossible to change. We noted in the reports the role of an “encouraging” leader trying to stimulate those subordinated to him to learn and apply his knowledge. Student EA0208 commented:

“My boss supported me greatly, encouraging me to take the course. He even became a little bothersome about this, because it is important for us and it is important for the laboratory”.

The “participating” leader was mentioned in the interview by student EA0508:

“In my laboratory everyone had taken the course, even the leader. That was the differential, because sometimes we take the course and we are not independent enough to buy a specific material. When the boss takes the course, he knows that it is necessary and doesn’t need to be convinced. He knows what should be done”.

The leaders interviewed understand the motivating and facilitating role they have and, to the possible degree, seek to meet the demands of the trained professionals. Leader EC0409 explained:

“All those participating in the course returned quite motivated, although we did notice that as time passed the motivation cools. We usually seek to give them great support, even though there are some things that we end up not implementing”.

In the last phase of the research – evaluation of the results – it was possible to verify that the professionals at the end of training had an impact on their workplace, disseminating the things they learned. In the interviews the students reported that they sought to share what they had learned by using different strategies, many times associated and simultaneous. Some try to talk with their colleagues, and to serve as an example by altering their work posture. Others made guidelines, books and legislation available during the training to be consulted by the entire team. And there are those who organized seminars in their laboratories. Student EA047 reported:

“Participation in the seminar was not voluntary. As our laboratory is a national reference and not everyone has had the opportunity to do the discipline or the course of biosafety, then this was the only way to sensitize the entire group. The seminar took place on three different dates and covered 100 per cent of the laboratory teams”.

Participation in the course, as related by boss EC0309, did not always result in change, but rather allowed the professional a deepened understanding of his workplace, which we think is essential for implanting biosafety management.

“All of the students that participated, even those that did not bring a concrete contribution, began to see the biosafety actions that we do in the laboratory with other eyes”.

The study also allowed the professionals to be more conscious of the risks to which they are exposed and as a consequence they use more personal protective equipment (PPE\textsuperscript{2}). Evaluating the consumer report supplied by the Materials Management Service\textsuperscript{3}, relative to the years 2008/2009, we noted an increase in PPE\textsuperscript{2} consumption (22.82 per cent), such as disposable medical coats (with bacteria filtration index greater than 90 per cent) and which substituted the cloth coats, procedure and nitrile gloves, masks and facial protectors.

\textsuperscript{2} Personal Protective Equipment (PPE) are all of the devices of individual use to protect the health and physical integrity of the worker, such as facial protectors, medical coats, gloves, etc.

We further sought evidence of the effect of the course on the professional lives of the employees at IOC by tracking the post-training consequences consulting different documents, such as reports, meeting minutes and congress annals, etc. In 2009, in Rio de Janeiro, there was the VI Brazilian Congress of Biosafety, with the participation of the IOC professionals who offered lectures, coordinated round-tables and presented studies. We verified in the annals that 13 posters were presented by professionals that participated in the Course of Biosafety in Biomedical Research Laboratories. From this total, eight reports (61.53 per cent) included successful experiments implemented in the research laboratories where genetically modified organisms are manipulated, in Scientific Collections, Reference Services, in the insectary and biotery of animal experimentation at the Oswaldo Cruz Institute.

Corroborating the internalization of these values, the students reported on the dissemination of the content learned beyond the institutional limits. The student EA0108 reported:

“We planned a continuing education course for biology teachers and introduced biosafety in the course. A member of the Biosafety Internal Commission of the IOC was invited to teach the course. In all the practical classes, biosafety was emphasized. At the end, the students had a seminar on biosafety, creating a didactic transference of the contents learned to be able to use them in the daily activities at school. It was very interesting”.

Discussion

The reason for evaluating a training program is to determine its effectiveness13. The Kirkpatrick model is considered “state of the art” where the subject is the evaluation of training programs16, congruent with the principles of adult education17 and applicable in formative actions – traditional and distance – whether corporate or educative18. The data collected at the first level – reaction – were seen by the PTPB coordination as an opportunity for improvement, as they effectively indicated what should be altered or improved. Beni et al15 affirmed that the participants that had not reacted favorably were probably not motivated to learn. According to the authors positive reactions cannot guarantee learning, but negative ones, certainly, reduce the possibility of learning.

For Kirkpatrick13 learning occurs when one or more of the following concepts are verified: an alteration of the way of perceiving reality, improvement of skills and/or knowledge increase. As previously emphasized in an earlier article14, the results of the pre and post-tests and of the seminars, once the students had the opportunity to examine their workplace realities, identifying problem-situation, formulating questions that were debated in the classroom, they made evident a type of learning that Moreira19 denominates of critical significance. He states:

[... through critical learning the student can be a part of his culture and, simultaneously, not be subjugated by it, by rites, myths or ideologies. It is through this learning that he can constructively deal with the change without being dominated by it, manage information without feeling impotent in the face of its great possibility and flux velocity, take advantage and develop technology without becoming a technophile. Through it he will be able to work with uncertainty, relativity and non-casuality, probability, the non-dichotomization of differences, with the idea that knowledge is our construction (or invention), that we merely represent the world and never directly capture [...]

In the third evaluation – behavior – we observed that there are variables that can influence the results of the training programs20, such as the adjustment of the laboratory infrastructure, purchase and availability of protection equipment (personal and collective) and
a favorable organizational environment (conditioned by the posture of the immediate leader and the other work colleagues).

Kirkpatrick warns that the person needs to be willing to change, that he must be disciplined and display consistent effort, but that there will be no transference of what was learned to the workplace if the environment is not precise. This environment depends greatly on the immediate leader who supports, encourages, facilitates. It is important to maintain focus of the objectives to be reached. But, these in turn, should be plausible, compatible with intentions and principally with the available resources. In this sense Broxado arguments “Ideas alone are not enough, the people to make these viable and concrete are necessary”.

In the evaluation of results we verified that knowledge learned when placed into practice promotes changes. The trained students adopted a prevention behavior, making use of personal protective equipment and demanding physical adjustment of the laboratories. Furthermore, disseminating knowledge and establishing relationship networks with other professionals trained in the search for shared solutions, establishing collective organizational competence. This competence is described by Soto Urbina and Lima. Thus, the attitude of the professionals evaluated here proved the premise of man as a social being, in constant relation with other men and with his environment, transforming it and being transformed by it.

**Conclusion**

Therefore, we concluded that the interventions were not punctual, centered on the activities and the relationships developed in the classroom. We could summarize that the know-how on an institutional level resulted from the combination and application of knowledge and skills that were incorporated by the individuals from the Course of Biosafety in Biomedical Research Laboratories, when they were able to identify and understand the important elements of the norms that focus on environmental sustainability and collective health. We noted that, just as in individual learning, in organizational learning an advance in the continuum will always be possible, adding up three assumptions the conceptual, the practical and the ethical.

Through their training programs, institutions can consistently consolidate and disseminate their values and basic principles, to be incorporated by the individuals, becoming their behavior mainspring, in the case of a more prevention attitude at the workplace. The evaluation of the professional training offered is fundamental, as it makes it possible to identify opportunities for improvement in the process of teaching and learning, besides verifying the effectiveness of the course, and the effect on the institution.
References


