

THE ROLE OF eLEARNING IN SUPPORTING ANALYTICAL LABORATORIES

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The Centro de Investigación en Contaminación Ambiental, Universidad de Costa Rica (CICA-UCR), is among other tasks responsible for the analysis of pesticide residues and the range of environmental contaminants and is accredited under ISO/IEC 17025-2005. ISO/IEC 17025 stipulates that new staff must be trained before undertaking laboratory work. The IAEA Collaborating Centre for eLearning and Accelerated Capacity Building for Food and Environmental Protection provides basic training courses over the Web (<http://elearning.iaea.org>). Students can take the courses at any time but they should complete the online examinations successfully before undertaking laboratory work or research projects. The focus is on training-the-trainer, whereby alumni should train at least two other scientists, thus accelerating capacity building. In addition, trainees are encouraged to add training materials either by developing new course content or translating existing course content. ATutor provides an open source Web-based eLearning environment designed to facilitate accessibility and now laboratory networking. CICA, in cooperation with the Advanced Radiation Technology Institute Radiation Application Research Division of the Korea Atomic Energy Research Institute, share a long-term vision of an external M.Sc. that would be offered through the collaborating institutions and respective universities. The aim is to build regional laboratory capacity to tackle pressing food and environmental problems.

Introduction

The Centro de Investigación en Contaminación Ambiental Universidad de Costa Rica (CICA) is a research unit of the Universidad de Costa Rica (UCR) and was created in 1982. In 1995 CICA, supported by IAEA, began to implement a Quality Assurance System according to Good Laboratory Practice (GPL) principles. In 2000 CICA was accredited under the Guide ISO/IEC 25 for 49 analyses for water quality and pesticide residue analysis. In 2003 the transition commenced from ISO/IEC 25 to ISO/IEC 17025-2000 and accreditation was obtained for 96 assays in water quality and pesticide residue analysis. Now CICA completed the transition to the 2005 version and renewed its accreditation for the next four years including other assays in air quality and sampling.

Accreditation gives formal recognition of the competence of the laboratory to perform specific tests. In Costa Rica, Ente Costarricense de Acreditación (ECA) is the accreditation body created by law in 2002 according to the National System for the Quality Law (Law No 8279). This law requires laboratories performing analyses for the Government, i.e., pesticide residue analyses, to have its tests accredited.

This presentation is about how the FAO/IAEA eLearning system ^[1] is helping to maintain accreditation and address training needs in a rapidly changing environment.

Pre-requisites

Since 2000, CICA has trained more than 25 IAEA fellows in pesticide residue analysis, GAP, quality management and more than 45 Costa Rican staff from a wide range of backgrounds and experience. A training-the-trainer approach is used so each staff is assigned at least one mentor. Typically, he or she introduces the eLearning system. While most learners find the browser-based interface intuitive, a tutorial is available for reference ^[2]. The starting point for analysts is Laboratory Pre-requisites 1 ^[3]. The course familiarizes new staff with: safety precautions and emergency measures; know how to handle labelled compounds and radiotracers safely; ability to prepare chemical solutions, calculate concentrations of solutions, and know how to make correct dilutions; safe use of the laboratory equipment; the principles of safe waste management; good cleaning procedures. New staff can take each module in a linear fashion. For registered users the system opens up where the trainee last left off. Alternatively, more experienced analysts may only need to scan a topic. The course map or right hand navigation links help learners quickly access information.. Thus, trainees are able to tailor the learning process to their specific needs and background knowledge.

For example, a course on “Handling Pipettes and Syringes” ^[4] may sound trivial and unnecessary. Yet experience has shown that many problems do occur with both the reliability of results and safety issues. Handling pipettes and syringes correctly is essential for good analytical performance and reliable results. To ensure repeatability and accuracy of measurements, new staff must have good pipetting techniques. Proper maintenance and correct calibration of pipettes and syringes are also essential especially given new requirements under ISO/IEC 17025-2005.

Document control

Documentation of work is a key activity in a laboratory and is required by internationally accepted quality assurance standards such as Good Laboratory Practice (GLP) and ISO/IEC 17025. The importance of documentation of work is demonstrated by a simple and strict statement:

“If you did not write it down, you did not do it.”

The Documentation of Laboratory Work course ^[5] gives an insight into the importance and scope of adequately documenting laboratory work. The course references the quality assurance standard of the laboratory. In this regard, it is essential that the documentation is tailored according to laboratory needs and actual practices. CICA conducts in-depth training as and when required. This approach combines the eLearning material and on-the-job training to ensure that analysts have the appropriate skills for the task at hand. This helps address the information overload suffered by new staff while meeting the requirements of the laboratory’s quality system. Documentation of Laboratory Work has another feature that CICA uses, namely examinations. The results help new staff and mentors identify weak areas and target what additional training is needed. They also document staff training for auditing purposes.

Instrumentation

CICA has a high performance liquid chromatograph/mass spectrometer, gas chromatographs/mass spectrometers and the required minor laboratory equipment. ISO 17025 requires that the instrumentation is under statistical control. Pesticide residue analyses at parts per billion or lower, is a challenging task. New analysts are encouraged to complete the Pesticide Residue Analysis course ^[6]. It takes analysts through the steps in pesticide residue analysis including: sample preparation; extraction and clean-up, quantitative determination of the analyte; estimation of uncertainty of results; confirmation of the analyte's identity; and quality control procedures for pesticide residue analysis. Again this is a starting point for more detailed CICA training materials in Spanish that eventually leads to the certification of new staff for those instruments under statistical control. At the moment, the main value of the eLearning is to ensure that analysts have the prerequisite skills and competencies to improve their career prospects and value to CICA.

Maintaining accreditation

Management and staff commitment are the keys to maintaining laboratory accreditation. This requires a very deep knowledge of those parts of the quality system they are responsible for as well as an overall knowledge of CICA activities. CICA activities include monitoring the implementation of good agricultural practices (GAP)^[7]. Staff are also encouraged to take the Pesticide Management course to help analysts understand the language used in related fields^[8]. This course addresses the challenge of pest management through the control of pests in a way that ensures biological diversity, preserves the environment and fosters human and animal health. More targeted training may be required such as the course on Ecological Risk Assessments of Pesticides^[9] that provides those dealing with pesticide registration instructions about the risk assessment process and how it is used to evaluate the potential impacts of pesticides in agricultural environments. The approach is to build on existing local knowledge/experience about a familiar “reference” pesticide and compare a new candidate pesticide with the “reference” using relative risk, i.e., high quotients indicate higher risk. Quality managers/auditors may take the Conformity Assessment course^[10], which aids laboratories in preparing themselves to comply with the relevant quality standards.

Outcome-based performance programming is now the rule for donor organizations. IAEA’s Department of Technical Cooperation has contributed a course on Project Management^[11]. The course gives an overview of what constitutes Project Management. It introduces a commonly used project management technique: the logical framework. Finally, it provides case studies to be used as examples when planning IAEA Technical Cooperation Projects. Soft skills such as Time Management are increasingly recognized as the key to addressing the exponential increase in knowledge and the human “bottle neck” in applying that knowledge. The Time Management course^[12] guides staff in selecting the best techniques for them and their working conditions.

Converging technologies

One of the strengths of the FAO/IAEA eLearning system is the web-browser interface. This is the same interface used by the Bika LIMS^[13] under consideration by CICA as a replacement for the paper-based quality management system and as a tool for feeding back information to clients. The problem was how to merge these two disparate developments seamlessly in the context of the laboratory quality management system. Apple’s iPod Touch provided a solution that enabled analysts to access the Web via the built in wireless network (Wi-Fi) and a “light weight” text reader BookZ. CICA is currently exploring a server based implementation utilizing virtual Windows and Linux machines to network instruments and improve security. These changes are revolutionizing laboratory work, where and how learning is undertaken and giving the freedom to learn continuously.

IAEA Collaborating Centre Learning and Accelerated Capacity Building for Food and Environmental Protection (EACB)

The EACB was inaugurated on 16 July 2007. The initiative combined three world-class research/teaching institutions in Costa Rica, the Republic of Korea, and Singapore. CICA is the lead institution, or Collaborating Centre, acting on behalf of the designated laboratories in relations with the IAEA. The laboratories in Korea have facilities for food manufacturing, environmental monitoring and radiation technology for related industrial, agricultural and biotechnological applications, including research and training capabilities.

The impetus for the EACB was the strong synergies between eLearning and hands-on-training. Training is resource intensive, particularly when travel is involved. Thus, training activities need to be cost-effective to be justifiable. This applies particularly to people already in the work force, who may have to pay for the training, but also have to account for work time spent on training. Accelerated capacity building is envisaged as step-by-step approach that meets the demand for efficient information dissemination through eLearning when, where and as it is required. The eLearning system implements a

“Lego” building block strategy that enables re-use of information blocks, thus avoiding unnecessary duplication of work and wasting of resources. Documents are typically disaggregated into smaller parts such as a glossary terms, references, multimedia items, and frequently asked questions. These information subcomponents can then be aggregated into knowledge objects, such as eArticles and slide shows and, at the top of the pyramid, over-arching eLearning courses on a specific topic. ATutor implement accessibility standards as well as the Sharable Content Object Reference Model (SCORM) compliant learning management allow the sharing of content amongst other systems. The low distribution cost of sharing course over the Web allows anyone with Web access to take courses for free. The long-term vision is to have sufficient courses for a post-graduate M.Sc. offered through participating universities. The model for this is yet to be developed but is expected to see credits being earned in the workplace and a possible reduction in the initial cost of higher education, which has become a barrier to developing knowledge based economies.

Conclusions

Costa Rica has long given priority to health, education and environmental sustainability. This has enabled UCR to invest heavily in human resources, quality and broadband Web access. This investment has enabled CICA to gain knowledge and experience in implementing and maintaining laboratory accreditation. Knowledge that is now shared regionally and globally.

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1. FAO IAEA eLearning
<http://elearning.iaea.org/>
2. ATutor HowTo: Part I
<http://elearning.iaea.org/ATutor/bounce.php?course=27>
3. Laboratory Pre-requisites 1
<http://elearning.iaea.org/ATutor/bounce.php?course=64>
4. Handling Pipettes and Syringes
<http://elearning.iaea.org/ATutor/bounce.php?course=22>
5. Documentation of Laboratory Work
<http://elearning.iaea.org/ATutor/bounce.php?course=90>
6. Pesticide Residue Analysis
<http://elearning.iaea.org/ATutor/bounce.php?course=37>
7. ([http://www-infocris.iaea.org/en/w3.exe\\$GloSearch?ID=27355](http://www-infocris.iaea.org/en/w3.exe$GloSearch?ID=27355))
8. Pesticide Management
<http://elearning.iaea.org/ATutor/bounce.php?course=38>
9. Ecological Risk Assessments of Pesticides
<http://elearning.iaea.org/ATutor/bounce.php?course=84>
10. Conformity Assessment
<http://elearning.iaea.org/ATutor/bounce.php?course=89>
11. Project management
<http://elearning.iaea.org/ATutor/bounce.php?course=53>
12. Time Management
<http://elearning.iaea.org/ATutor/bounce.php?course=42>
13. Bika open source web-based laboratory information management system
<http://bika.sourceforge.net/>
14. Chart Trakker in Management Innovations XVII
http://www.ache.org/PUBS/Research/poster_05.pdf
15. Accessibility challenges with mobile lifelong learning tools and related collaboration
<http://www.idi.ntnu.no/~divitini/umocec2003/Final/Ahonen.pdf>
16. iPod Touch from Wikipedia
http://en.wikipedia.org/wiki/IPod_Touch