

## **Fostering e-learning in medical education: the EuroVacc team experience**

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Theme: The value of Distance, Flexible and ICT-based Education in specific contexts

Context: II - Post-Secondary or University Education

This work focuses on the approach of the EuroVacc e-learning core-team, an interdisciplinary workgroup dedicated to the development of e-learning projects in the medical fields. The group is running three major projects: Immunology Online (IOL), OCTAVE (Online Collaborative Training for AIDS Vaccine Evaluation) and OOL (Oncology Online). IOL is a web-based curriculum that draws expertise from the five Swiss medical faculties and targets medical and graduate students. IOL employs a “blended learning” strategy (face-to-face and e-learning) as an alternative to traditional lectures. OCTAVE is a pilot e-learning program initiated by EuroVacc and the HIV Vaccine Trials Network to deliver training in priority areas such as good clinical and laboratory practices, HIV pathogenesis and vaccinology. OCTAVE targets the need for on-site, face-to-face training visits (i.e. training in laboratory methods). Oncology Online aims at integrating clinical and molecular aspects of cancer. IOL, OCTAVE and OOL are hosted by the Bio-med platform ([www.bio-med.ch](http://www.bio-med.ch)) of the Swiss Virtual Campus program. The platform scaffolds a Learning Management System for creation, updating, revision and delivery of web content. It supports an active and flexible e-learning environment, tailored to the needs of a diverse clientele. Our approach has been tested in multiple contexts, namely problem based

learning, article based learning, lectures and, more recently, protocol-based learning. Each project counts with the commitment of experts from a variety of collaborating organizations, whom provide relevant material in basic and applied biomedical sciences.

Keywords: e-Learning, medical education, learning management system, development, application.

## 1. Introduction

During the last decade, internet-based learning has been introduced as a way to renew teaching and enhance a variety of learning experiences. University educators have been applying e-learning as a way to enhance the teaching of several disciplines. They rely on the unique combination of teaching and learning resources that can be exploited in e-learning environments, some of which are listed below:

- **accessibility:** e-learning is not limited by the physical proximity of a student to an individual teacher or institution. The Internet offers the potential to expand access to a global panel of experts and fosters collaboration with other students from different cultural backgrounds or work environments. In this sense, e-learning has the potential to reduce the disparities among individuals or groups of students, while promoting independent learning (Semenov, 2005);
- **dynamic representation of concepts through hypermedia:** by combining and linking text, animations, video and simulations, hypermedia provides a resourceful and engaging medium that may facilitate understanding of complex concepts that were traditionally conveyed in static diagrams. (Tricot et al., 2000; Kozma, 2003);
- **communication:** information and communication technologies (ICT) have evolved to support teaching methods that complement or, when feasible, supplant traditional face-to-face modes of instruction. Classical ITC tools such as e-mail and chat sessions have enabled new interaction avenues between teachers and students worldwide. These tools have proved to facilitate communication, for instance, by allowing students to pose questions that they might be uncomfortable to ask in a classroom setting, particularly if they feel challenged by material they perceive others to have mastered (Semenov, 2005);
- **autonomous learning:** in times of a ever-growing wealth of information, it became a consensus that students are demanding greater flexibility in how and when they prepare for classes. This is particularly true for the training of students and for the objectives of continuing education. E-learning have been acknowledged as an effective approach to run life-long learning programs (UNESCO-ILO, 2002).

However, the successfully implementation of e-learning is nevertheless a challenging entrepreneurship. For the purposes of the present discussion, it is convenient to point out four major challenges:

- **changing current views of teaching and learning:** the age of knowledge and information poses a challenging background for those engaged in any instructional activity. Given the impossibility of conveying and updating the whole of the information, educational objectives should focus on selectivity rather than on completion. It prompts a structural change in curricula and in the current views of those who teach, and those who learn. On one hand, such change is crucial to successfully implementing e-learning. On the other hand, it is by applying e-learning and demonstrating its effectiveness that one can subdue inertial scepticism and foster the change;
- **heterogeneous audience:** teaching and learning for selectivity is tightly bound to teaching and learning for life, i.e., preparing students to autonomously identifying their learning goal and digging out relevant information from the wealth of available sources. Consequently, the potential audience of training programs overrun the capabilities of the current educational system. All professionals are expected to enrol in continuing education programs, often in fields of expertise different from the original formation (European Parliament and the Council of the European Union, 2003). The case of health education precisely illustrates the dimension of this challenge. As will be discussed later in this article, lowering the death row of diseases such as AIDS is heavily dependent on training a *clientele* of professionals which is increasingly diverse regarding access to technology, geographical distribution, age, motivation, previous knowledge, and socio-economical, cultural, and linguistic assets (Davis et al., 2004);
- **flexibility:** facing the challenges outlined above requires a flexible environment that can be tailored to different audiences. It must also address strategies adopted by educators that will eventually incorporate e-learning in their *praxis*. Thus, the e-learning environment should be conceived and developed to provide innovative solutions for the several teaching and learning strategies currently adopted (lectures, problem based learning, case based learning, etc). Additionally, it must handle the myriad of learning possibilities regarding place (face to face/blended/distant) and time (synchronous/asynchronous). Flexibility is, therefore, a solution and a challenge in itself;
- **development and maintenance:** the promise of increased accessibility and innovation through e-learning comes at a cost: development and maintenance require considerable institutional resources to support expertise in information technology and to engage faculty members, who might have limited experience in teaching online.

This work reports the activities of the EuroVacc e-Learning Core Team and its strategies to cope with the challenges outlined above. It focuses the team's major achievements and presents its framework for development and application of e-learning in medical and health sciences education.

## 2. e-Learning programs in medical and health sciences

The EuroVacc e-Learning Core Team is the e-learning branch of the EuroVacc Foundation, a Swiss Foundation based in Lausanne. The Core Team in Lausanne participates since 2004 in the creation of distant learning programs in collaboration with national and international organizations and institutions. The

team is mainly concerned with the development and application of e-Learning in biomedical and health science education as follows:

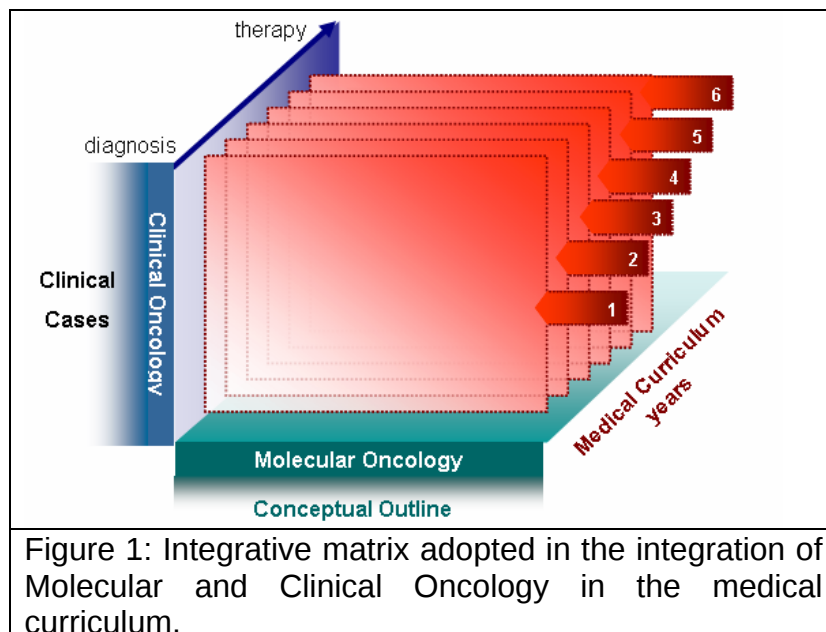
- **Development activities:** starting from content provided by experts in several fields of biomedical sciences, the Core Team develops interactive content modules combining hypertext, illustrations, animations and videos for each of its e-learning programs. In order to take the most of the content, specific learning tools have also been developed, enabling a broad array of applications. The modules and the learning tools are hosted in a platform specially designed to scaffold content development and application;
- **Application activities:** the application of e-Learning programs is driven by institutional needs. The experience accumulated so far resulted in the development of e-teaching approaches for various audiences including academic and industrial organizations in the developing and developed countries. The application of e-learning programs in each institution is based on portals created to allow customization of content and access for specific educational goals. The portals and their resources are also hosted in the same platform used for development.

Efforts are being pursued by the Core Team in partnership with other national and international institutions to develop biomedical on-line training. The efforts resulted so far in three ongoing programs: Oncology Online (OOL - <http://ool.bio-med.ch>), Immunology Online (IOL - <http://iol.bio-med.ch>) and OCTAVE (<http://octave.bio-med.ch>).

## 2.1 Oncology Online

Oncology Online is intended for medical students, graduate students, post-doctoral fellows, residents, and clinical fellows. The e-Learning Core Team in joint effort with Oncology-oriented scientists and clinicians is developing an integrated teaching program combining molecular and clinical oncology. The program will initially be implemented at the School of Medicine, University of Lausanne and subsequently proposed to the other Swiss and international Higher Education organizations.

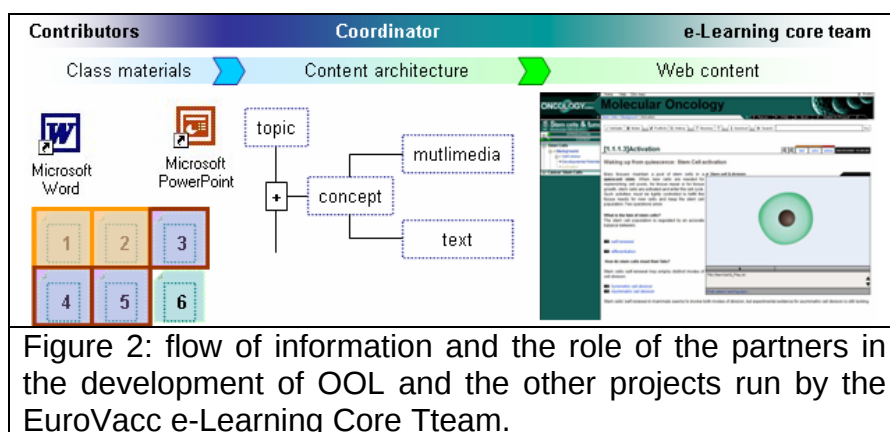
OOL share a central objective with IOL and OCTAVE: integrate concepts of clinical and basic science within the medical and health science education. From the content development side, this objective is addressed by adopting an integrative matrix. The matrix correlates the conceptual frameworks of clinical and basic sciences and their insertion across the curricula (Figure 1).



Molecular oncology consists of 7 modules entailing 32 major topics. This outline serves as the architecture of molecular oncology, it determines content development and it will direct the students to the appropriate online resources. Given the applied nature of its content, clinical oncology is structured through a collection of clinical cases regarding the most common types of tumors. Whenever it is pertinent, clinical cases are developed along the following lines: genetic and environmental predisposing factors; pathological and cellular characteristics; molecular basis (activation of oncogenes, loss of tumor suppressor genes, etc.); clinical evolution and available therapeutic interventions.

Consistent with the principle of integrated curriculum, Molecular and Clinical Oncology are developed by workgroups composed of specialists from both clinical (applied) and basic sciences focusing on one type of tumor. The first workgroup has developed a problem based approach related to breast cancer. This integrated framework will later be extended to other cancer types such as colon, lung cervix cancers, melanoma and leukemia and lymphoma.

The development of Oncology Online content illustrates a common principle that also drives content development in IOL and OCTAVE: interdisciplinary



cooperation among scientific contributors and the e-Learning Core Team. Following this principle, information flows from the original materials provided by the contributors to the web environment. The process is orchestrated by the coordinator of each project, who bridges the knowledge of the contributors and the expertise of the e-Learning Core Team in order to create, revise and publish the content in OOL's, IOL's and OCTAVE's web environments (Figure 2).

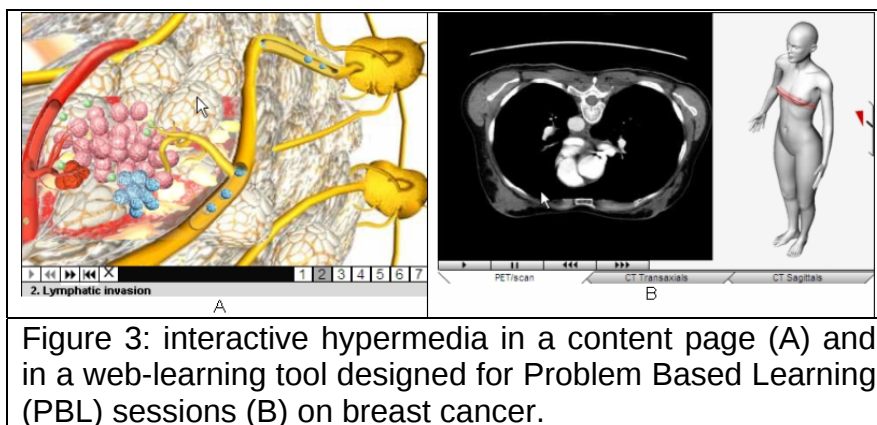


Figure 3: interactive hypermedia in a content page (A) and in a web-learning tool designed for Problem Based Learning (PBL) sessions (B) on breast cancer.

in figure 3.

Such cooperative work yields quality instructional hypermedia and e-Learning tools, tailored to active teaching strategies such as Problem Based Learning (PBL), as shown

## 2.2 Immunology online

Immunology has often had the reputation of being complex and daunting among medical & biology students. This is mainly attributed to the fact that the knowledge on the immune system is continuously evolving and is teeming with details and a several unanswered questions. Additionally, much of the coursework in basic and clinical immunology at the university level relies heavily on content-centered traditional approaches to learning, in which updates to textbooks and curricula often lag behind rapid scientific advances and, in which, course content is revised on an annual, or less frequent, basis. Moreover, it was increasingly recognized that students are demanding greater flexibility in how and when they prepare for classes of immunology and related disciplines. In response to these challenges and to fulfil the desire to standardize learning opportunities across seven Swiss campuses, Immunology Online was launched as part of the Swiss Virtual Campus in 2001.

Immunology Online is a web-based immunology course for students of immunology at the bachelor, masters, and doctoral levels. Immunology Online offers a complete course that is used in conjunction with existing traditional immunology courses. IOL's content is broad and entails 6 modules on basic and 8 modules on clinical immunology. IOL's comprehensive content is accessible by means of three distinct learning gateways:

- **"Structure-function" approach:** the "structure–function" approach makes use of high-quality hypermedia to provide an in-depth exploration of the structural organization of lymphoid organs and their respective roles in the development of an immune response.
- **Case-based learning (CBL):** clinical CBL encourages small groups of students to analyse and explain relevant immunological principles. As students proceed through a case study, an Internet-based application assists them in identifying gaps in their knowledge and defining their learning objectives. The present version of the Internet-based application has benefited from feedback from educational experts, and it continues to undergo improvements;
- **Annotated article-based learning (ABL):** ABL offers an opportunity for students to familiarize themselves with the content and format of original scientific publications. Various tools have been created to help students to read and interpret the literature. These include the following: guidelines for reading, evaluating and presenting the findings of an article; active links to specific pages of laboratory techniques or other relevant contents; and an extensive glossary of terms. This method of learning is particularly valuable for students who are planning careers in basic or clinical research since it helps them to build lifelong learning skills and promotes greater insight into the design of experimental procedures.

IOL program was initially conceived for Swiss students; however, through a collaboration with the World Health Organization, content will also be shared with medical students and healthcare personnel of developing countries in Africa, Asia, and South America.

## 2.3 OCTAVE: Online Collaborative Training for AIDS Vaccine Evaluation

Significant resources have been committed by trial sponsors and governments to facilitate technology transfer to developing world investigators and laboratory specialists. In-country and international fellowship programs and research internships are important components of this effort. However, evolving technology presents another solution to offer practical training to key personnel in geographically diverse locales. Distance education using the Internet has been successfully implemented to train service providers to offer tailored HIV prevention interventions, and similarly, it is believed that e-Learning approaches can be built and maintained to support staff dedicated to moving the HIV vaccine development effort forward.

To support this essential capacity building effort, The EuroVacc Foundation, the HIV Vaccine Trials Network (HVTN), supported by the U.S. National Institutes of Allergy and Infectious Diseases (NIAID) and other partner institutions have spearheaded OCTAVE, a new on-line training program. Contributing authors representing a wide array of collaborating organizations and industry partners will provide relevant content for use by a diverse audience of investigators and support staff.

OCTAVE addresses key training priorities including Good Clinical Practices (GCP), Good Clinical Laboratory Practices (GCLP) and laboratory methodologies, vaccinology, and HIV immunopathogenesis. This pilot program was initiated in the fourth quarter of 2004 and piloting modules of the vaccinology, GCP and laboratory methodology training have started in 2006 (Debard et al., 2005).

GCP training relies on article and case-based learning to clarify investigator responsibilities outlined in regulatory guidance from the International Conference on Harmonization (ICH) and U.S. Code of Federal Regulations.

Vaccinology training will employ self-directed and tutor-assisted case-based instruction to help investigators synthesize pre-clinical safety and immunogenicity data to build a rationale for moving a hypothetical candidate HIV vaccine into clinical trials. This training will be also be informed by relevant background contributed by subject experts in HIV immunopathogenesis.

The laboratory assays and methodology section of the site will encourage users to enter a virtual laboratory and assume the role of a technician, investigator, or member of the quality assurance team. Students will choose to enter different areas of the lab to learn more about flow cytometry, peripheral blood mononuclear cell (PBMC) processing, and HIV diagnostics, among other topics. It is hoped that this web-based resource will be used to help prepare staff for upcoming, on-site training visits by trial sponsors and to reinforce key messages and techniques thereafter when clinical sites are expected to perform these functions autonomously.

### 3. Tailoring e-learning for specific audiences

The core team is providing portals that allow adjustment of the content and the pedagogical approaches of the various e-Learning programs to the specific needs of Institutions and Organizations. The portals provide:

- A plastic e-Teaching management system that is controlled directly by a given institution or organization and which can easily be interfaced with existing teaching activities and adapted to various audiences;
- A rapid mobilization of the content and pedagogical approaches across different e-Learning programs to build a adapted curriculum;
- Multiple sessions management capabilities that allow to organise simultaneously distinct training activities and a follow up of teaching activities over long periods particularly suited for continuing education.

Several portals have been implemented and are operational. These include:

- **The WHO portal:** The WHO portal has been designed for the trainees of the WHO/TDR program supported by the Swiss Office for Cooperation and Development. The portal gives access to content of Immunology Online and OCTAVE directly related to the course on immunology, vaccinology and biotechnonology of infectious diseases. The trainees receive their login two month before the face to face courses in Lausanne or in developing countries, are asked to acquire the basic concepts of immunology and pass an online pre-test.
- **The UNIL portal:** The UNIL portal is for the medical and biology students of the Faculty of Biology and Medicine of the University of Lausanne. It offers integrated teaching programs on Immunology and Oncology. It gives access to problem based and article based learning approaches adjusted for each year. The students have access to virtual tools including a virtual microscope developed by the University of Geneva and to a virtual laboratory.
- **The EPFL portal:** the EPFL portal is for bachelor and master students at the Federal School of Technology in Lausanne. It provides a combined training in immunology and microbiology. It serves also for a master devoted to the modelling of the immune system.
- **The HVTN portal:** the HVTN portal has been designed for the training of clinical investigators

### 4. Scaffolding e-Learning with the Biomed platform

The ability of the Internet to foster an integrated approach to learning depends, in part, on the technological capacity of the platform that is used. The Biomed platform embeds a learning management system (LMS) developed by the Core Team. The LMS hosts the three e-Learning programs and the four portals, allowing adjustment of the content for specific audiences. Besides, the LMS system provides utilities for the key actors involved in e-Learning:

- **The learner:** a personalized folder, annotations, self evaluation tools in the form of quizzes, handouts, glossary, Q&A and FAQ;
- **Groups of learners:** "who is online?" tool, Forum;
- **Teachers and tutors:** mailing, group management, agenda, news, statistics, follow up of evaluations

The LMS enables instructors or online tutors to organize content in a range of ways. Students can complete the required elements in a time frame that is compatible with the guidelines of each institution. It can help both the instructor and the student to keep track of progress, which ensures that students advances in their exploration of the knowledge data base according to the educational objectives set by the teaching staff. In addition to scaffolding the LMS, the Biomed platform supports all phases of e-Learning process from development to testing and implementation. Used by Oncology Online, Immunology Online and the OCTAVE project, the platform provides operational means for development, storage and access of instructional hypermedia.

## 5. Perspectives

e-Learning programs such as Immunology Online, Oncology Online and OCTAVE are examples of a trend in expansion across several fields of knowledge: using the Internet to deliver up-to-date educational information in an accessible user-friendly way to a broader audience.

These activities, among others, are expected to foster lifelong learning for individuals who are committed to continuing to build their skills in response to a rapidly changing society. In July 2004, the European Parliament and the Council of the European Union adopted ambitious proposals for a new generation of programmes — entitled Lifelong Learning — in the fields of education and culture, and these include an e-learning action plan.

According to the Council of the European Union, at least 12.5% of the adult population in working-age will enrol lifelong learning activities, of which e-learning initiatives will feature prominently, at a cost of €44 million in the next two years (European Parliament and the Council of the European Union, 2003).

This stresses the stated commitment of the European Union towards an 'advanced knowledge' society with sustainable development, job creation and greater social cohesion.

We believe that e-learning has the potential to provide a convenient avenue to such goals. However special concern must be given to maintain high-quality standards while expanding the action fields of e-learning programs. This is certainly another challenge that e-learning developers must face, and a central objective to pursue in current and further e-learning projects.

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