A Concept for eLearning postgraduate and continuous education in laboratory medicine

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Introduction

Electronic learning (e-Learning, eLearning) is a type of computer-supported education/learning or most often web-based education that is used either as a complement to face-to-face learning (blended learning) or as standalone and distance learning modules.

eLearning was first used as a practical tool to distribute information and content including course logistics (schedule and location, list of professors and students), course handouts, webstreaming or webcasting of conferences. eLearning's current objectives have evolved towards the development of a large array of novel interactive pedagogical approaches, using the new technologies available on the web (networks, multimedia), to increase the learners' knowledge and performance.

eLearning usually requires a learning management system (LMS), a software to deliver, track and manage training. Several LMS have been developed, are available and unfortunately have generated a «war» of platforms. Concentrating on content and learning activities is far more important than the platform, since platforms can easily be interfaced through content management systems (CMS).

Some history

eLearning started with a correspondence course in stenography proposed by the Boston Gazette in 1728. The term «distance education» was cited for the first time in the programme of the University of Wisconsin at Madison. In 1920, S. Pressey of Ohio State University built the first teaching machine for multiple choice questions. From then on, numerous learning programmes were developed on proprietary computer systems by various public or private institutions.

In Switzerland, an ambitious project, the Swiss Virtual Campus (SVC), launched in 2000, was designed to promote the use of new information technologies and develop networks of online teaching units on a common Swiss platform that could be integrated into the university curriculum and shared by all universities. 111 projects in fourteen disciplines were launched (http://www.swissvirtualcampus.ch/display.php?lang=1&bname=all_projects_discipline). The overall feelings about the SVC's outcome are at present rather mixed – particularly in view of the major financial investment – due to poor integration of the eLearning material into the curriculum, lack of network coordination, emphasis on IT and pedagogical teams rather than teachers, underestimation of the additional work required from teachers for content production, resistance of professors and students to the new technologies of communication.

Federal funding of SVC was secured until 2008 on the assumption, by the Secretariat of Education and Research (SER), that the universities, the Federal Polytechnic Schools and the «Hochschulen» would take over. Since this did not happen, many projects stalled and websites were closed. However, the SVC provided a major stimulus for the launching of eLearning in the universities. The concept of a Swiss shared academic eLearning network was forsaken, and each university currently develops its own projects on its own platform. Immunology online (IOL), the most important program of the Health Sciences eTraining (HSeT) Foundation, is one of the few surviving SVC projects [1]. The HSeT Foundation, a non-profit organisation created in 2006, hosts and develops eLearning programmes devoted to immunology, AIDS vaccinology, oncology, laboratory medicine, pharmacology and haematology. HSeT is financially supported by several partners, Foundations (Loterie Romande and ISREC), the National Centre of Competence in Molecular Oncology Research (NCCR), the National Institute of Allergy and Infectious Diseases (NAID), the HIV Vaccine Trial Network (HVTN), the International AIDS Vaccine Initiative (IAVI), and grants from private companies (no strings attached). HSeT works on a partnership basis, i.e. projects developed by a partner are immediately available to all partners. HSeT's programmes are also made available at no cost to institutions from developing countries (www.hset.org).

Advantages of eLearning

The advantages of eLearning are:

- **Renewal of teaching methods:** Novel pedagogical approaches are the real added-value of eLearning, a way to renew teaching and enhance a variety of learning experiences. The attention of learners can be captured in new ways by combining text, animation, video, virtual microscope and simulation, to facilitate understanding of complex concepts. This is a particularly helpful approach for the biomedical sciences [2].
- **Flexibility and convenience**: Students' learning is no longer limited by physical proximity to an individual teacher or an institution. This potentially provides students with access to a global panel of subject experts and fosters collaboration between students from different cultural contexts or working environments. Trainees can work anywhere, provided there is an internet connection, and can proceed at their own pace.
- **Costs and benefits**: Institutions adopting eLearning have realised that this approach requires an investment in content development, web design,

dissemination of training, and site maintenance. Nonetheless, academic, non-governmental and industry partners are investing in the promise of increased accessibility to up-to-date training to support their own capacity-building efforts. Investments in eLearning are expected to reach € 40 million in the next few years, most of which will be allocated to lifelong learning programme initiatives.

While the real cost of traditional face-to-face teaching is almost impossible to estimate, the costs of eLearning can be quantified. As a result, it is often criticised as too expensive. The initial cost of implementing an eLearning programme is indeed high, but the cost of training decreases drastically as more learners use the eLearning course material. Updating and maintenance of eLearning material is also cited as an issue. In practice, updates can be more easily implemented and less costly than updates of books or paper-based traditional teaching media [2, 3, 4].

Traditional versus novel eLearning teaching approaches

Traditional eLearning approaches include online content in the form of:

– text, tables, illustrations and graphs prepared for a course or a workshop;
– video or audio files, webcasting or webstreaming of oral presentations.

While offering flexibility and easy access worldwide, including developing countries, these approaches do not offer real interactivity.

Online encyclopaedias represent a mix between traditional and novel approaches, depending on their degree of built-in interactivity, and self-evaluation tools. Students, however, tend to be perplexed and unable to focus when offered too much resource material.

Novel eLearning approaches consist in the development of interactive learning activities. These activities are intended to help the student to define his/her learning objectives on an individual basis. Learning can then be pursued in various formats, i.e. selected chapters from the online encyclopaedia or a traditional support (book, course handouts).

Examples of novel eLearning pedagogical approaches include case-based learning, article-based learning, protocol-based learning, SOP-based learning, virtual microscopy and virtual laboratory (see Table 1).

• **Case-based learning** is an educational format centred on the learning derived from a clinically based problem. Case-based learning focuses on the building of knowledge. The method encourages independent learning and gives learners practice in tackling puzzling situations and defining their own gaps in understanding, in a context of relevant clinical problems. It is a way of learning which encourages deeper understanding of the material rather than superficial coverage.

• Annotated **article-based learning** offers an opportunity for trainees to familiarise themselves with the content and format of original scientific publications. Various tools have been created to help trainees to read and interpret the literature. These include guidelines for reading, evaluating and presenting the findings of an article, active links to specific pages on laboratory techniques or other relevant content, and an extensive glossary of terms.

• **Protocol-based learning** uses a mock research protocol supplemented by helpful background material to illustrate key concepts in clinical trial design and implementation.

• **SOP-based learning** is an educational format that discusses complex assay-specific standard operating procedures (SOPs) written in the Clinical Laboratory Standard Institute (CLSI) format. These SOPs are enhanced with pop-ups, graphics, and animations to illustrate how these assays are performed. SOP-based learning is intended to provide laboratory staff at all levels with a fundamental understanding of laboratory SOP structure and content.

Table 1
Summary of interactive learning activities.

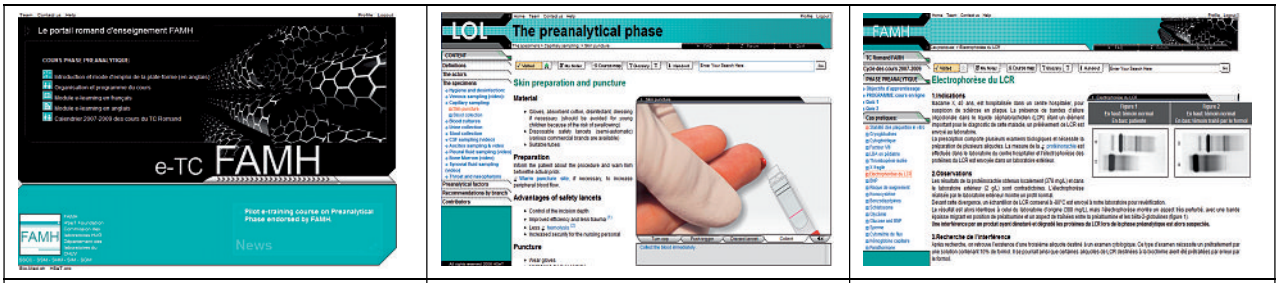
Approach	Source material	Skills	Activities
Case-based learning	Clinical cases	Problem solving, Conceptual understanding Communication	Web learning, Group discussion
Article-based learning	Scientific or clinical articles	Conceptual understanding Writing experimental protocols Communication	Web learning, Group discussion
Protocol-based learning	Clinical protocols	Writing protocols, Conceptual understanding, Problem solving	Web learning, Group discussion Lectures
SOP-based learning	Standard operating procedures	Lab expertise, Conceptual understanding, Writing SOPs	Web learning, Group discussion Lectures
Virtual microscopy	Histology, cytology, pathology	Diagnostic skills	Web learning, Group discussion
Virtual laboratory	3D working spaces	GCLP implementation Problem solving Lab assay expertise	Web learning, Group discussion

Developing new eLearning activities

The development of new eLearning activities is best achieved through close collaboration between technical and scientific teams. The scientific partners provide educational objectives and expertise in production of content and learning activities. They work closely with scientific coordinators who establish the content architecture, teaching approaches and the choice of the multimedia support, and with the technical team for the creation of animations and learning activities. The final product is then published online, used for teaching and constantly revised and updated according to the user's feedback.

A concept for eLearning in laboratory medicine

eLearning is particularly well suited for motivated learners drawn from a heterogeneous educational background who appreciate the opportunity to study with an independent and flexible schedule. It is thus best suited for postgraduate and continuous education, such as medical laboratory training in Switzerland.



a b c

Figure 1.
The Pre-analytical Phase: Tronc Commun Romand FAMH eLearning portal (a), resource website with theoretical and interactive content (b), example of a practical case proposed by a student (c).

Tronc Commun Romand FAMH portal: a pilot postgraduate eLearning experience

Twenty days of «Tronc commun» (common core) FAMH courses are mandatory for postgraduate training in Switzerland. Adaptation of common learning objectives for these courses is difficult, due to the candidates' heterogeneous pre-graduate educational background, laboratory fields studied and training phase or type of activity (see Table 2).

Table 2
This table shows the large degree of heterogeneity of FAMH candidates attending the course on the Pre-analytical Phase.

Branch	#	Pregraduate education	#
Clinical chemistry	7	Biology	11
Genetics	2	Medicine	5
Haematology	6	Pharmacy	3
Immunology	1	Other	3
Microbiology	1		
Pluridisciplinary	5		
Practical activity	**#**	**Training phase**	**#**
Yes	19	Beginning	9
No (not in the lab)	3	Midway	8
		End	5

A blended course (i.e. eLearning followed by a face-to-face course) is the best adapted solution in this context, because it allows the students' knowledge level to be matched up during a pre-workshop or pre-course eLearning phase.

A pilot course on the Pre-analytical Phase was endorsed and supported by the FAMH committee and took place in 2008. An 8-week eLearning preparation phase was followed by a 1-day face-to-face course. An FAMH portal was created and the programme was posted on the portal to guide the 22 registered students in their learning approach (Figure 1). The learning activities consisted of a theoretical repository module taking advantage of the characteristic features of web-based programmes (animations, slide shows, videos, hyperlinks, online references) and two mandatory assignments:

1. The participants had to send the tutor a case illustrating a pre-analytical event or problem experienced in their daily practice. Each case was then rapidly posted on the site in an instructional format.
2. The participants had to answer two multiple choice questionnaires which were posted online during the last phase of the course.

During the face-to-face meeting, the answers to the questionnaires were reviewed, speakers presented some important topics and 4 participants were selected for an oral presentation of their practical cases. The course ended in a round-table discussion. A thorough evaluation of the course followed, from which it emerged that the majority (18/21) of the students expressed the wish for similar additional e-training courses and voted for a blended course format. They thought that the learning effort for a course of this kind was more demanding (15/21) and that more content was assimilated (17/21) than in a traditional face-to-face course. Such results indicate that the main objective of eLearning had been fulfilled, i.e. better learning as a result of more active student participation.

Tronc Commun Romand FAMH portal follow-up

Statistics in Laboratory Medicine is the second eLearning course currently under development for the Tronc Commun Romand FAMH. Additional modules hosted on the Pluridisciplinary eLearning Portal (see below) could be used to organise further Tronc Commun blended courses.

Concept for a pluridisciplinary eLearning portal

Since 2008, several laboratories have expressed interest in obtaining access to the Preanalytical Phase module as a continuous education resource for their personnel. A portal different from the specific Tronc Commun Romand FAMH portal would need to be built for this purpose, but although this could be done easily there is no point in developing portals for a single course and for individual laboratories. Indeed, to be successful, this portal should be populated with more than one course and accessible for several institutions.

The following concept is therefore proposed (Figure 2):

- Creation of a pluridisciplinary eLearning portal for distance continuous education in laboratory medicine (CLE).
- Access to existing courses (Pre-analytical phase, Statistics in Laboratory Medicine, urine tutorial, Synopsis in Haematology, Haematopoiesis, Basic Concepts in Immunology, primary and secondary lymphoid organs, including virtual microscope, PCMC SOP-based learning, and several cases for case-based learning).

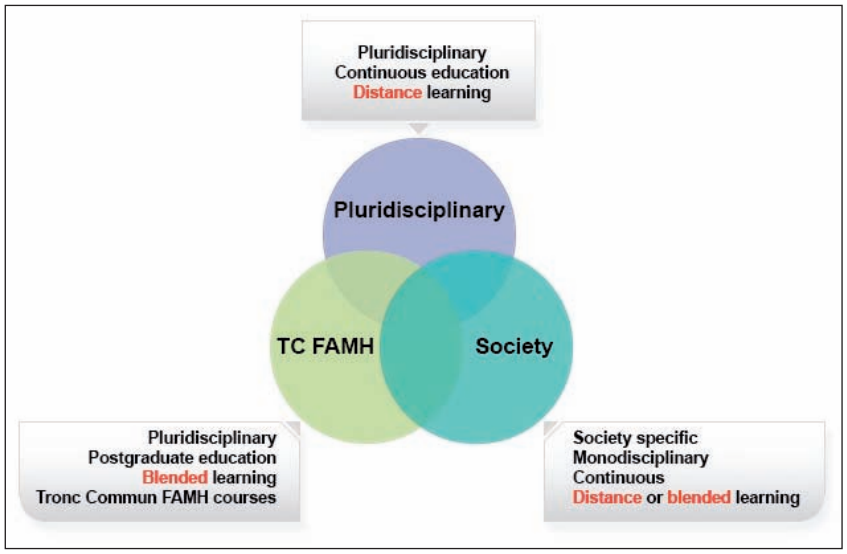


Figure 2.
A concept for eLearning education in laboratory medicine: interaction of pluridisciplinary, tronc Commun FAMH and society-specific portals.

– Development of additional modules [Prevention, Security and Hygiene (SSM), Synopsis in Immunology (SSAI), Synopsis in Genetics (SGM), quizzes, article-based learning modules, additional case-based learning].

The principle of this pluridisciplinary portal would of course need to be endorsed by the FAMH Expert Committee, the FAMH Executive Committee, the SAMW Kommission Weiterbildung zum Laborleiter, all scientific societies members of FAMH, and SULM. Scientific endorsement for existing or new courses would be needed from each scientific society concerned. Resource material for additional courses or activities could be provided by each scientific society, by interested individuals or by companies.

Finances

As already mentioned, creation of a new portal and posting of existing material could be done at relatively low cost. New modules could be supported financially by the society concerned (either entirely or in proportion to the number of FAMH students registered in each branch). Possible sponsorship could be sought from foundations involved in education, private companies, private laboratories or SULM. The portal could be managed by an editorial board, in a way similar to a journal. The financial participation of each society in its construction would give full access to the portal to all its members.

Based on an LMS allowing the control of each activity by each registered learner, distribution of CLE credits or certificates for a small fee to individual members would also be possible. This financial aspect could be managed by the FAMH secretariat and revenues invested for further developments.

Society specific continuous education eLearning portal

The majority of the scientific societies' members of FAMH are more concerned with continuous medical education (CME) than with CLE, i.e. continuous laboratory (FAMH) education. These societies might be interested in developing their own CME portal. The modules developed on these CME portals could also be adapted for CLE on the pluridisciplinary portal. The CME portals might in turn be interested in hosting modules developed for the Pluridisciplinary Laboratory eLearning Portal.

Conclusion

In the field of laboratory medicine a multitude of resources are available on the internet (public websites, paying websites), constructed by groups of people (Wikipedia), associations (of patients, for instance), of scientific societies, universities, hospitals, laboratories, suppliers or individuals. The maintenance and updating of these resources is rightly open to question, especially when passing from information to education. Hence it is of crucial importance that the building of content be performed in collaboration with experts and/or scientific societies. People in active life are currently overloaded with their daily duties, particularly with the pressure always to produce more with fewer resources. However, a large amount of teaching material is lost whenever its author retires. Such material can serve to build eLearning modules for an eLearning CLE portal. There have also been suggestions that FAMH candidates be involved and contribute to building content for the portal. In addition, the recommendations issued by the appropriate scientific commissions of the scientific societies are an additional source of underused material for teaching. Their speedier publication in an interactive eLearning format on a pluridisciplinary eLearning portal would increase their impact and visibility to the laboratory community.

This Swiss CLE pluridisciplinary eLearning portal could become a model for EFCC (European Communities Federation of Clinical Chemistry), a member of the International Federation of Clinical Chemistry (IFCC), which listed eLearning as a priority in its 2009 strategic plan. Finally, this CLE portal could be offered at little or no cost to institutions in the developing countries, where teachers and books are not as easily available as in Western countries.

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