
eBioMED.ch© [1] is aimed mainly at the development of a learner-centred content management delivery system dedicated to life sciences. Such a teaching prospect requires significant means in terms of implementation. However, the use of a complete web-portal can help to limit the financial and time costs of this implementation. Thus the main goal of this program is to propose such a portal, including in particular, tools for the generation of personalized and customisable pathways, for document sharing, for learner tracking, and finally and obviously, currently proposing the whole scientific content related to general physiology, neurobiology, molecular and cell biology, immunology and endocrinology. The program is open to any new suggestions and contributions.

1.2. Delivery Strategies and Didactic Anchors

The information delivery aspect of a learning system can be characterized by considering the relationship between knowledge providers and learners. The relationship between these two actors can be defined in three categories:

i) *One-to-Many* is an old delivery tool, such as hard copy delivery. It would be defined as one expert source delivering his/her knowledge to many learners based on the same skill. This design has already been tested for a long time. Its

implementation requires minimal means and makes it possible to distribute contents towards a homogeneous population of students. From this point of view, the student adapts to the expert. It should be noted that this concept is not adapted to lifelong learning, especially within the framework of biomedical sciences, which should be a very scalable approach.

ii) *One-to-One*: Expert adapts to individual learner. This approach involves a high cost and is very difficult to scale, at least when considering the implementation by traditional means (direct conversation, personalized dialogue, etc.). New learning technologies are one of the responses for reducing these difficulties and costs.

iii) *Many-to-One*: This is the real challenge. Although this strategy is often considered to provide a poor quality control, *eBioMED.ch*© has tried to fill this gap and we think it has succeeded. In addition, it offers very low cost perspectives and is the most relevant and effective approach to just-in-time lifelong learning within the framework of biomedical sciences. It should be perfectly adapted to the scale of current knowledge change, the rapid transition to a knowledge-based society and demographic pressures resulting partially from an ageing population in North America and Europe.

1.3. Learning Management Strategies

Three categories of learning management strategies are frequently mentioned in the related literature: i) instructor-based, ii) discipline-based and finally iii) program-based strategies:

- i) *Instructor-based strategy* is often described as the strategy of the "lone ranger" [2]. This consists of content developed within the strict framework of one course, written by one instructor. This type of content responds to the expectations of the implied instructor. Inconsistency between various courses of the same discipline often results from such an approach.
- ii) *Discipline-based strategy* offers good results in terms of consistency between courses of the same level and discipline but a poor coordination between similar courses.
- iii) *Program-based strategy* allows coordination between all the courses. It even tolerates coordination between diverse disciplines if an identical didactic method is applied to all the content delivered. It should be noted that such a management strategy is complex but once again the use of new learning technologies allows a reduction in complexity.

1.4. Assessment

Lifelong learning is about acquiring and about all kinds of abilities, interests, knowledge and qualifications across the life span. Assessment is usually related to the institutional qualification process. Although *eBioMED.ch*© provides numerous tools for evaluating the learners, qualification and certification is the responsibility of the institution in charge of the learning program. With *eBioMED.ch*© learners approach learning material and experiences with their own learning styles and preferences.

2. *eBioMED.ch*© Specifics

2.1. Delivery Strategies

New technologies open innovative perspectives in information delivery. Although the above-mentioned categories generally remain valid, they no longer cover all the possible combinations. The three types of distribution can benefit from available technologies to extend their fields of services and applications.

The One-to-Many strategy (*e.g. ex-cathedra* courses) can be enriched by videos, animations or other forms of presentation support. Feedback systems (classroom vot-

ing systems) allow the instructor to have an immediate return on her/his work.

Moreover live broadcasts or archived broadcasts of courses *via* synchronous (*e.g.* web conferencing) or asynchronous communication tools (differed diffusion of videos) broaden the public audience. This is due to a diffusion dissociated from time and/or space. Nevertheless, in this case the relation between actors remains 'traditional' and based on the passive transmission of knowledge.

The Many-to-One strategy profits from new tools designed to improve the organization and the follow-up of information, and its delivery to the target public. In our point of view the Many-to-One strategy takes more advantage of the possibilities offered by new technologies. The variety of information sources, the short duration of knowledge's life, the need for the refreshing and updating of professional knowledge as well as the great range of people who desire training, seem to speak in favour of a Many-to-one approach. However, very few e-learning systems have chosen this approach alone. Most of the broadcasting information systems for training use the classical One-to-Many method. One of the main purposes of the *eBioMED.ch*© program is, to a certain extent, to solve problems linked to the organization, to cooperate on an expert network and to offer a highly personalized broadcasting system which takes into account the targets and knowledge of each learner.

To understand this difference better we can compare the classical approach using the new technologies with the Many-to-One approach, which is proposed by *eBioMED.ch*©.

Taking the classical approach, information is organized according to a sequential scheme, which is pre-defined by the instructors). This scheme is the same for all learners. Hyperlinks, whenever there are any, do not permit an exit from the scheme established by the instructor: When a learner clicks on a hyperlink text, the system opens a document which is always the same for all the learners. The individual way of learning is based only on the choice each learner has, to click or not, on a particular link. This navigation method, which is well known by web users, has been widely exploited by the training systems such as OPAL modules [3], long before the web came out. These systems have gone even further in the individualization, by proposing a reorganization of the navigation based on self-evaluation of test results.

With *eBioMED.ch*©, we have gone even further by associating dynamic hyperlinks navigation, Internet network and a training documents database (learning objects).

eBioMED.ch© allows each learner to reach his/her learning objective using a network of concepts delivered and described by various content providers. *eBioMED.ch*© allows:

- i) The generation of on-the-fly learning modules regarding learner objectives, his/her background knowledge, and all prerequisites necessary to understand the topic.
- ii) The generation of self-evaluation sessions based on the same principles.
- iii) The management of a network of learning content providers.
- iv) The creation of links between learning documents using a database of prerequisites/related topics.
- v) The use of learner background knowledge and learning objectives to create dynamic hypertext links between documents.

It is important to note that content providers can participate in *eBioMED.ch*© without developing complete modules. Using the prerequisites/related topics information, each document becomes part of the concept network, contains dynamic hyperlinks and will be delivered to the right user within a module generated on the fly. These modules constitute the shortest way for a learner to reach his/her objectives. This pathway will cross all necessary prerequisites for understanding the requested topic. Using information collected during the self-evaluation, the system will select only prerequisites that are not yet mastered by the user.

In addition to personalized modules, the web portal provides a new kind of hypertext link. These links can be activated according to three modes (Fig.):

- i) *Classical Navigation*: the link is made to a target document provided by the author (clicking on the link will open the corresponding document)
- ii) *Search Link*: the link will run a search and will show all documents matching with the related subject/domain
- iii) *Prerequisites Pathway Link*: by clicking on the link the user will see a personalized pathway containing all necessary steps to understand the related subject/domain.

The latest link type is a powerful navigation tool specifically dedicated to learners. Using these links, the system will provide personalized modules with a set of dynamic hypertext links guiding the learner across his/her learning pathway. In addition, each self-assessment, by modifying the user's profile, gives the system the information required to adapt each hypertext link to the learner's background knowledge.

2.2. Learning Management Strategies

Before the appearance of modern information networks, a training device required, in addition to the instructors and the learners, a physical place (school, university) in which the instructor, the knowledge and the learner were put in contact. Moreover, diversification and specialization of the various fields of knowledge resulted in specialized training for which each instructor transmitted only knowledge of her/his own discipline.

The attempts to put the learner and his/her profile, objectives and constraints in the center of the learning device often faced, in addition to the inertia of the education systems, organizational problems, (difficulties of collaboration among the institutions, difficulties of collaboration between the disciplines), conceptual problems (how to connect knowledge coming from various fields, how to take account of the learner and his profile, how to control the acquisition of knowledge) and financial difficulties (how to personalize teaching without generating excessive costs).

By putting the learner in the centre of the learning device, *eBioMED.ch* proposes a new mode of management which cannot be easily classified in one of the three above-mentioned categories.

- i) The content providers can belong to different institutions. The contents offered by each instructor are in fact integrated in a network exceeding the traditional institutional framework. Nevertheless each instructor can remain contracted to his institution since the participation in *eBioMED.ch* program does not require a modification of the organization of the institutions essentially based on research.
- ii) The system based on 'prerequisites/related topics' allows the generation of training modules by picking up the resources in different documents coming from diverse institutions but also from different fields. This step does not require formal collaboration between the instructors, the fields and the institutions.
- iii) Thus *eBioMED.ch* can be used in various situations of the training process (basic curriculum at University, Master and continuous learning, specific in-service training, etc.) without requiring a heavy organization. The content providers take part in the program by publishing teaching documents and the users are helped in their learning process by *ad hoc* tools.

3. Assessment and Validation of Knowledge

The evaluation, but above all the validation of knowledge is, in any training device, the most regulated aspect and the heaviest to modify. *eBioMED.ch*, although proposing innovative modes of evaluation and validation, remains dependent on rules based on traditional schemes. These schemes propose in a general way the organization of the training and the validation according to pre-established curricula giving access to various types of recognition (diplomas, certificates etc.) Although such organizations seem necessary for the basic training, the postgraduate and continuous learning must allow an evaluation and a validation of the knowledge, which is more centred on the learners. The needs of the job market are in constant modification. Moreover the rigidity of curricula and the inertia of the offer to the demand do not allow those needs to be adequately met.

Simply stated, even the whole range of possible curricula does not match the richness and the diversity of the demand. We saw above how *eBioMED.ch* allows the personalization of the learning process by taking into account, *inter alia*, the specific objectives of each learner. At the limit, this system could provide a dynamic knowledge card, in perpetual movement. This

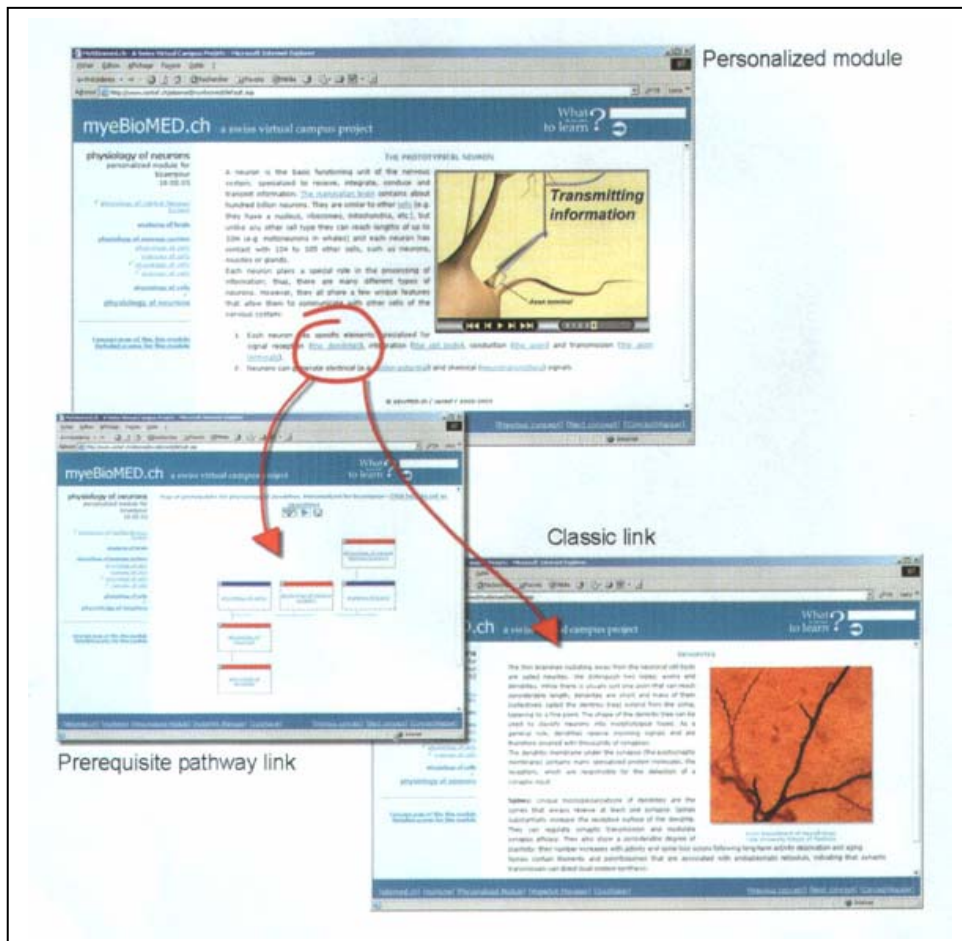


Fig. Dynamic hypertext links

system would not be complete if it did not offer a solution to formally validate the knowledge obtained by each learner.

Two major problems seem to be opposed to such an assertion:

- i) How to validate knowledge of each learner in fields where knowledge is quickly obsolete.
- ii) How to evaluate knowledge acquired in a flexible way, without formal control on the identity of the user.

eBioMED.ch© is able to generate self-assessment sessions based on the objectives and the profile of each learner. The results of those evaluations are stored by the system and constitute the user profile. This profile changes according to the user's actions. It also changes, and this is specific to the *eBioMED.ch*© system, according to the evolution of knowledge in the fields concerned.

4. Conclusions

eBioMED.ch© was developed to put the learner in the centre of the learning process. In addition we have built a system, which does not induce deep change in the organization of partner institutions. These goals would have not been reached without reforming the classical learning process and developing new navigation concepts (as prerequisites pathway link, personalized modules).

Future versions of *eBioMED.ch*© will provide tools allowing users to participate in a knowledge construction process.

Each learner will access a logbook containing users' documents and annotations. This information could be shared with other learners through the prerequisites/related topics network.

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