

# *A Java-Web-Based-Learning Methodology, Case Study : Waterborne diseases*

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## **1. Introduction**

One of the main uses of the web is informal learning through browsing. Even though the web was not initially designed for educational purposes, today's web technology is changing the educational environment. In this regard, the web is considered as a vehicle for disseminating course materials and for creating active learning, because of its hypermedia nature. One characteristic of the web is the instantaneous access to updated information which provides more flexibility by eliminating the risk of outdated [1], thus reducing costs.

This article is divided into four sections. The first section presents the capabilities of the web that are interesting for learning. In the second section, a framework for a web-based-learning system is described.

In the third section, we describe a java-based methodology for web-based-learning systems. Finally, an example of web-based-learning system illustrates this article.

## **2. Web Tools and training:**

We can summarize the capabilities of the web that are of particular interest in an educational setting, in two points: the web hypertext and hypermedia capability, and the web communications features.

### **2.1 The Hypertext/Hypermedia capability**

Hyper Text is defined as a collection of documents containing cross-references or links which allows the reader to move easily from one document to another with aid of an interactive browser program. Rather than the familiar reading of one page then the next, hypertext is a non-linear reading support.

HyperMedia is defined as an extension of hypertext that includes links to graphics, sound, video and other kinds of resources.

### **2.2 Communications: Email, Newsgroups and Faq Files**

The web communications play an important role in distant learning, especially email, newsgroups, and faq files.

Email allows users to communicate one to one or one to many basis.

Newsgroups are another valuable means of communication on the Internet. They provide a forum for discussion on a wide range of topics. By participating in newsgroups, a user can learn about a topic, ask questions for a group of interested individuals.. Newsgroups can serve as an "invisible college" by creating a mechanism for people to make announcements, share ideas, disseminate information and gain knowledge.

Most newsgroups maintain a list of frequented asked questions (Faq).

### 3. Web based learning systems features

According to [2], a comprehensive web-based learning framework may contain some of the following components:

*a. Asynchronous communication capability including posted discussion and email*

Asynchronous discussion is desirable between instructors and students and among students. It is a flexible means for learners to receive feedback from instructors and provides the opportunity for students to work together and learn from each other.

*b. Synchronous communication capability*

Although it is not essential, live conferencing may be of some value. Instructors and students may set up times for groups of course participants to meet in a chat room. As bandwidth barriers decrease it may become desirable to include desk-top video conferencing.

*c. Collaborative area for shared work space and application sharing*

The potential for online collaboration and work sharing advances the web-based learning framework from the sharing of content and information to fundamentally transforming learning and work.

*d. Course delivery*

The web-based learning framework can accommodate either instructor-led or independent study courses. The courses should be developed using theoretically sound principles of educational design for technology-based learning.

*e. Online testing*

Depending on the content and context of the courses, online testing capability may be desirable.

Nevertheless, such a framework does not fulfill the basic objectives of today's computer based learning systems. To attend this objectives, this framework should support student understanding by providing appropriate and immediate feedback, be integrated into the context of the course of study, and provide a high level of interactivity.

### 4. A java-based methodology

Most of current web-based-learning systems stay limited because they cannot provide control and guidance of the learner due to the lack of interactivity of the web.

Links between html documents remain the only pedagogical way used to guide the learner. But this kind of control does not allow individualized learning and cannot reason on students errors.

We propose to build a real "computer assisted learning" system that transcends the above weaknesses. This system is based on Java.

**4.1 The java Programming Environment** Java is an object-oriented programming language developed by Sun Microsystems[4], The java programming language and environment is designed to solve a number of problems in modern programming practice. According to Sun, java is simple, object-oriented, network-savvy, interpreted, robust, secure, architecture neutral, portable, high performance, multithreaded, and dynamic language [5].

Java programs fall into two main groups : applications and applets.

- A java application is a program written in the java language which does not require a browser to run, and in fact, java can be used to create all the kinds of applications that you would normally develop with a conventional programming language.

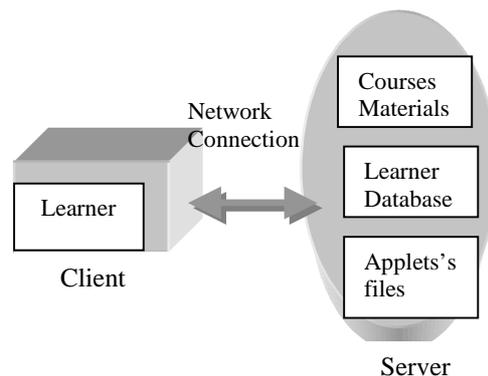
- A java applet is a small program which is downloaded over the world wide web and executed by a web browser on the reader's machine. It can be used to create dynamic, interactive web programs. Java enabled browsers recognize applet tags in HTML documents, and assign an area of the document displayed to the applet (just as they display images in documents). The browser then invokes the applet.

Because java applets run inside a java browser, they take full advantage of the environment the browser provides : an existing window, an event-handling and graphics context, and the surrounding interface. Given that java applets can be downloaded from anywhere and run on a client's system, restrictions are necessary to prevent an applet from causing system damage or security breaches [4]. If such precautions are not taken, java applets could be written to contain viruses or be used to compromise the security of the system that runs them.

In the following section, we will present a methodology for developing web-based-learning systems using java.

## 4.2 web-based-learning systems using java:

Figure 1 describes the architecture of the java-web-based-learning system.



**Figure 1**

The different modules of the system and their interactions are implemented as a single applet. This choice departs from the way most available web-based-learning systems have been implemented. The main reason is that we aim at offering the user an interface presenting all the features of the system, so that any component can be easily accessed via a mouse click.

An interface with menus, buttons, events control, is implemented easily exploiting the power of java's AWT[4].

### *a. Course Delivery :*

Courses are developed using the html language. A course covers a series of topics and each topic spans over several html pages. A page may include audio and images files.

The curriculum is modeled as a concept map[6].

*“Abstractly, concept maps are sorted graphs visually represented as nodes having a type, name and content, some of them are linked by arcs. Concretely, they are structured diagrams having discipline- and domain-specific interpretations for their user communities, and, sometimes, formally defining computer data structures.”*[7] Concept maps have been used for a wide range of purposes and it would be useful to make such usage available over the World Wide Web. In our context, a map can be viewed as a subway map. Courses are represented as main nodes or stations, while topics of a given course can be seen as secondary nodes or stations. A whole course can be seen as a subway line. Each node has a name: the topic of the course it covers. We associate to each node an url corresponding to the location of the relevant web pages.

One advantage of using java applets is that the courses map will always be present throughout the user’s session. The learner may visualize a course in one window and consult the course map window whenever needed. Hence, an overall view of the courses is always at hand.

#### *b. Testing :*

A good web-based-learning system must include a module for testing and evaluating the learner[2]. Currently, there are two ways supported by the web to implement this module : CGI and java applets.

The CGI (Common Gateway Interface) is a standardized way of writing scripts that the server will run when a request for a given URL is received. One particular use of CGI scripts is implementing gateways; i-e a gateway is typically a program that transforms information from one form to another.

In the implementation of evaluation module, two crucial issues are : The graphics capability of the interface, and its response time. In the following, these two criteria are used to compare CGI and java applets.

In a CGI-based approach, the communication between a client and the backend system (learner database for example) must always go through the HTTP server, which may become a bottleneck. In addition, for every client request or server response, data must be converted from or to html format; thus increasing the system’s overhead.

On the other hand, a java applet is capable of making its own network connections without any intervention by the HTTP server.

Using CGI, the presentation graphics are limited since an HTML document is static and does not provide direct communication interfaces. It is possible to make presentation graphics only through generating GIF images or other graphic formats, this method is slow and time consuming because all the images have to be generated by a CGI program on the HTTP server side. One of the major advantage of client/server computing is that all the specific functions e.g. graphical presentation of query results should be performed at the client side. This is only possible if a web client is capable of performing active functions. With Java, this is possible.

Java based user interfaces are more flexible than CGI based ones because applets can perform complex computations rather than just submitting information from forms to the web server. CGI based programs do not allow user interaction beyond form filling and they use web documents as program output.

For these reasons, java applets are more appropriate to build testing and evaluation module.

#### *c. Individualize Learning :*

A web-based-learning system must maintain a learner’s database which contains learner’s specific information such as: name password, course level, exercises and grades.

- Course Level: with this information, the system can know which courses the learner has taken before. Then, it can be positioned directly in the next topic or course.

- Exercises and marks: with this information, the system can summarize all the exercises resolved by the learner and the grades obtained.
- These two points ensure an individualized learning.

#### ***d. Communications :***

The big advantage of implementing learning systems on the web is the communication aspects[8]. In this context, a web-based-learning system must offer two types of interaction : Student-instructor interaction and student-student interactions. These two ways of communication can be done with java. The software can embed a java mailer module and a java 'chatting' module. The java Network library offers all the basic primitives to perform these tasks.

## **5. SEMITHI: A practical example for java-www-based-learning**

SEMITHI is a web-based-learning system written in java for teaching waterborne diseases to medical students[9]. SEMITHI is part of IISCPWD project. IISCPWD intelligent information system for the control and prevention of waterborne diseases.

SEMITHI involved three main modules:

- A tutorial module
- An hypermedia module
- A tele-discussion module

### **5.1. The Tutorial Module :**

This is the most important component of the system. It guarantees interactivity and monitoring of the learner's sessions. This module is composed of:

*a. The Learner database :* it contains all the information concerning a learner :

Static information : name, password

Dynamic information : Lessons taken, exercises done, grades obtained

The access to the learner database located in the server, is performed via the RMI (remote method invocation) from Java.[9]

*b. The session-control class :* It updates the dynamic information of the learner database. It acts also as a gateway between the tutorial module and the hypermedia module.

*c. The exercise class:* Two types of exercises are proposed: MCQ (multiple choice question) and clinical cases. The exercise class analyze the learner's answers to a question and grants him a second chance to answer if the former is false.

### **5.2. The Hypermedia Module :**

This module includes general courses about waterborne diseases and detailed courses about two waterborne diseases: cholera and typhoid.

The course curriculum is visualized as a map (figure 2). To learn about any topic, the learner can only click on the corresponding node. The topology of the map suggests the chronology with which the courses/topics should be read.

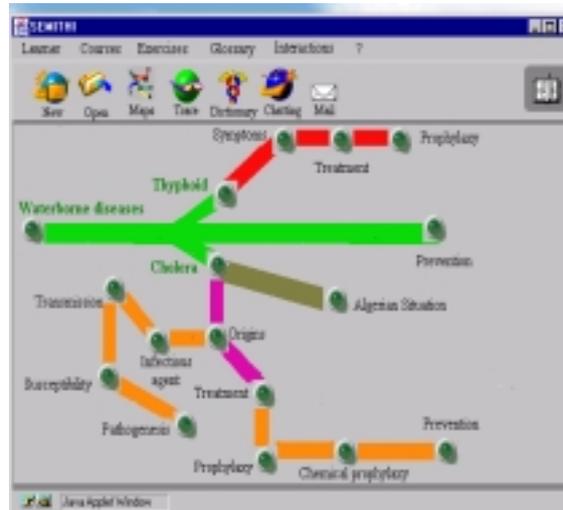


Figure 2

### 5.3. The Tele-discussion Module

SMITHI provides a java mailer module and a java 'chatting' module using sockets[9].

## 6. Conclusion

The web technology provides a novel setting for learning.

In this paper a methodology for developing www-based-learning systems using java is described. The java-based approach is flexible, portable and robust [4]. A user can download the client software in the form of a java applet directly from the web. The learning sessions can be individualized and controlled.

SEMITHI, the prototype described in this paper proved the power of java to develop in the web, interactive learning systems.

## References bibliographiques

- [1] David M. Kennedy, Carmel McNaught, "Interactive multimedia and good teaching", University of Melbourne, //ultibase.rmit.edu.au/Workshop/kenne1.html, 1997.
- [2] P. Duchastel, S. Spahn, "Design for web-based Learning", Presented at WebNet'96, San Fransisco, USA, Octobre 1996.
- [3] B. Dodge, "Distance Learning on the World Wide Web", Published in 1996 as Chapter 12 in Brandon, B., et al, Computer Trainer's Personal, ISBN 1-57576-253-6
- [3] J. Nicaud, M. Vivet, "Les Tuteurs Intelligents: Réalisations et tendances de recherches" T.S.I, 1988
- [4] L. Lemay, C. L. Perkins, "Teach yourself Java in 21 days", 1996
- [5] D. Bank, "The Java Saga", <http://www.hfd.hr/Student/clanci>, 1996
- [6] Brian R. Gaines, Mildred L. G. Shaw, "Concept Maps as Hypermedia Components", Knowledge Science Institute, University of Calgary, 1995
- [7] Gaines, B. R., and Shaw, M. L. G. "Concept Maps as Hypermedia Components", Knowledge Science Institute, University of Calgary. <http://ksi.cpsc.ucalgary.ca/articles/ConceptMaps/>, 1995
- [8] B.R. Gaines and M.L.G. Shaw, "Implementing the learning web", Proceedings of ED-MEDIA'96 : World Conference on Educational Multimedia and Hypermedia, 1996
- [9] F. Allouti, F. Smati, "Conception et réalisation d'un système de téléenseignement pour les maladies à transmission hydrique", Mémoire d'Ingenieur, 1998