Supporting some pedagogical issues in a Web-based distance learning environment

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Abstract

Development of new functionalities that can enable learning environment to enhance and promote learning is a major concern in the computer-assisted instructional area. Actually, one of the most important issues in this area is distance education. New technologies such as the Internet contribute to this issue. A distance learning environment called CYBERPHYSIQUE is presented in this paper. CYPERPHYSIQUE is an interactive computer-assisted environment that integrates an automatic generation kit for pedagogical activities. This environment is supported by a WWW client and is accessible through the Internet. CYBERPHYSIQUE offers some relevant functionalities, by taking into account the learner cognitive, affective and conative capabilities, by giving access to some metacognitive information during the learning process, by supporting automatic generation of learning activities, by supporting collaborative learning and by managing the feedback to be given to the learner. Physic sciences is the application domain.

Key-words : Web-based learning environment, distance learning, pedagogical (learning) activities, knowledge representation, student modeling, learning style, educational hypermedia.

Résumé

L’apprentissage à distance devient un axe important de recherche. Ce type d’apprentissage s’avère utile pour la formation continue. Nous présentons dans cet article un système sur WWW destiné à l’enseignement à distance. Ce système inclut deux environnements: un environnement auteur et un environnement d’apprentissage. Le premier, dédié aux enseignements, concepteurs d’enseignement et spécialistes du contenu, permet à ces derniers de mettre du contenu nécessaire à l’enseignement. Le second, accessible à distance, est destiné aux apprenants et offre des fonctionnalités essentielles pour favoriser l’apprentissage: l’apprentissage collaboratif, la prise en compte du profil de l’apprenant, le support à la métacognition, la génération automatique d’activités pédagogiques, la rétroaction adaptée et le style d’apprentissage. Le système est appelé Cyberphysique et est actuellement conçu pour supporter l’enseignement de la physique et plus particulièrement de la dynamique. L’inclusion d’un atelier virtuel de manipulation permet aux apprenants d’expérimenter des lois de la physique. Les outils proposés sont suffisamment génériques pour supporter l’enseignement d’autres matières en sciences appliquées.

Mots clés : Environnements d’apprentissage sur le WWW, enseignement à distance, représentation de connaissances, activité d’apprentissage, hypermédia éducatifs, style d’apprentissage, modélisation de l’apprenant.

1. Introduction
Hypermedia environments are becoming essential tools for the enrichment of pedagogical values in the teaching area. Their use has been made easier by the arrival of the WWW (World-Wide Web) which makes it possible to access hypermedia resources available on the Internet. However, numerous ILE (Interactive Learning Environments) offer a variety of functionalities without taking into consideration their relevancy to the learning process. In fact, the majority of these systems completely forget the ABC's of basic pedagogical values.

Research has shown that the implementation of some learning activities in the form of hypermedia can significantly improve the acquisition of cognitive abilities for some learners (Marchionini, 1988; Jonassen et Grabinger, 1990). However, ILE exploit learning activities which are not adapted to the learner. These systems neglect essential pedagogical factors such as the consideration of the student's values, learning style metacognition and his preferences regarding feedback. The hypermedia system elaborated in this paper, available through distance education, takes into account all of these factors. This system, called Cyberphysique also allows the generation of numerous learning activities which are suited to the student, at relatively low costs. The creation of pedagogical activities usually means high costs (Murray et Woolf, 1993). Yet, a well-constructed hypermedia ILE can generate a variety of relevant learning activities at lower costs.

Furthermore, it appears that although programs offer increasingly sophisticated functionalities in answer to the ever-increasing demands of users, the efficiency of work accomplished with computers does not necessarily progress at the same rate (Barthe, 1995). It is for this reason that in Cyberphysique, an emphasis is placed on five (5) factors which we consider important in an ILE:

- the student's values (cognitive, affective and conative aspects);
- communication elements between peers;
- assistance;
• distribution of resources;
• user-friendly interface.

The objectives which have been set for the development of *Cyberphysique* are the following:

1. Develop a multimedia product for distance education which includes two environments:
   > a learning environment, interactive, user-friendly, distributed and accessible through the Internet;
   > an authoring environment in order to allow the elaboration of content.
2. Develop a complete Physics science course using the authoring environment;
3. Make the authoring environment available to the concerned parties (teachers, instructional designer, domain experts...) in order to enrich and adapt the content;
4. Deliver the content to the students using the learning environment;
5. Validate the proposed system by an research «in situ» involving the students.

In the following sections, we will describe in detail the *Cyberphysique* system which is the object of our proposal.

2. **A Web-based environment for distance learning**

The proposed system contains two parts: a student learning environment and a distributed authoring environment.

2.1 **Features of *Cyberphysique's* learning environment**
According to Wilson (1995), learning environment refers to a space which allows the student to access and process information from the resources, thus making sense of it, in order to solve problems. According to Bordeleau (1994), a computerized pedagogical environment involves helping the student to «learn» and «learn to learn». It is most desirable to develop constructivist multimedia learning environments in which the space offers a good variety of collaborative learning methods. Thus, the student is actively implicated in his own learning process, including the building of knowledge and is called to collaborate with his peers. *Cyberphysique* boasts a learning environment which takes into consideration student's values, collaborative learning, virtual and human assistance and a user-friendly interface. It also supports an automatic generation of pedagogical activities which are adapted to the learner.

![CyberPhysique -Élève](image.jpg)

Figure 1. An overview of Cyberphisique learning environment.
Pedagogical values and student profile

Certain aspects are crucial in order to facilitate the learning process for the student such as: offering adapted activities, producing appropriate feedback, favoring communication between students and offering assistance. Therefore, in order to ensure that these characteristics are present, it is important to take into account the student's values and the analysis of the student's reasoning depends strongly on the presence of these characteristics (Greer, 1996). Furthermore, research has shown that a student in a learning situation must be able to situate himself at any given moment during his learning process (Paris and Winograd, 1990; Derry, 1990). In an ILE, it is important, even essential, to be constantly aware of the student's values, activities and actions. Cyberphysique integrates a Learner Profile which meets the specification elaborated in Nkambou, LeFebvre and Gauthier (1996). During his first visit to Cyberphysique, the student will identify himself and answer a series of question which will allow the system to initialize the Learner profile. This questionnaire is based on the CAM-Battery (Kilonen and al. 1990). The student profile is called to evolve in a dynamic fashion during the student's entire learning process. This functionality is essential in a context of free practice because the student profile (Learner profile) will serve as a foundation to creation of adapted learning activities.

Human and virtual assistance

Two types of support are offered in Cyberphysique learning environment, a “human” support and a “virtual” support. The human support gives the student a chance to contact resource persons at precise moments. A dynamic palette which is integrated in the interface represents online human resources and their state (Figure 1). A series of colors are used to represent their state. A green light indicates that the person is available, while the red light indicates that the person is on line but busy. The black light means that the person is not accessible.

The virtual support offers help and assistance which are necessary to the student without the intervention of a human resource. Virtual support is accessible at all times during the
learning process. The system exploits the pedagogical expertise included, the structure of the content and the student’s profile in order to give appropriate feedback.

**Learning with peers**

*Cyberphysique* encourages and supports collaborative learning by offering a communication platform online. Thus, students can exchange and share their knowledge on the subject matter. Studies (Vygotsy, 1978, Bertrand, 1996) indicate that the socio-cognitive aspects of the learner are very important. Therefore, *Cyberphysique* has a tool which suggests various communication options, including communication technologies such as visioconference, E-mail and Electronic board. These communication techniques encourage exchanges and help between the students, favor collaborative learning and encourage the students to share at socio-affective levels. All of these elements are considered essential during a learning process. Communication models such as the one proposed by Chan (Chan and Chou, 1998) or by Frasson (Frasson and Aïmeur, 1996) could be very well included in Cyberphysique.

**Cognitive ergonomy aspects and metacognition**

The *Cyberphysique* learning environment has an attractive interface with useful functionalities. Learning systems are more and more powerful and complex and this implies that a student is mentally overloaded during problem solving or learning activity. The integration of new technologies of information and communication in ILEs suppose that the learner has already acquired a sufficient amount of knowledge to use the new tool or that the tool is so user-friendly that the learner can easily manipulate it. Thus, the learning environment which is proposed for *Cyberphysique* is very user-friendly. The interface is based on a metaphor of onglets which presents the various aspects of learning (choice of courses, lessons, workshops and direct manipulation, interactive simulation and evaluation…) (see figure 1). Furthermore, each of these aspects includes an hierarchical browser which allows the student to intervene at several level of
abstract of the subject matter: modules, chapters and notions. The help given by the system (glossary, objectives, …) depend to the level at which the learner is. For example, in figure 1, if the student asks for the glossary, only glossary related to gravitation will be displayed. By offering an hierarchical browser, the student can continually situate himself in his learning process. This represents a way to support metacognition.

**Generated pedagogical activities**

One of the interesting aspects of Cyberphysique is the possibility of creating and automatically generating a variety of learning activities at relatively low costs. The system takes into account the student’s profile in the generation of these activities. Furthermore, Cyberphysique plans to decrease the duplication of resources by offering a platform for distribution of resources. This platform allows authors (teacher, pedagogical designers, content specialists, etc.) to produce and stock locally basic resources accessible through the internet.

**2.2 Cyberphysique’s authoring environment**

As a support to the student’s learning environment, an authoring environment dedicated to teachers and pedagogical designers is created. This second environment of Cyberphysique is used to computerize curriculum elements and pedagogical material in order to make them available. By using this data, a computerized course (Physics course) will be developed and used in the learning environment. This computerized course will be created in collaboration with different partners: Ministry of Education, teachers… This authoring environment supports at all times the creation of evaluation activities that teachers can offer to learners. In return, teachers have access to students’ performances on evaluation activities. Furthermore, one of the objectives that Cyberphysique authoring environment aim for is to decrease teachers’ workload in relation to course preparation so that they can spend more time to helping, coaching and supervising.
2.3 Technological aspects and content

Although at the present time, the content proposed by *Cyberphysique* is related to Physics, it still remains that the system is a generic one and can therefore be adapted to other subjects. The approach which has been used for content elaboration is based on CREAM (Curriculum Representation and Acquisition Model) (Nkambou, Gauthier et Frasson, 1997).

*Cyberphysique* is a multimedia tool accessible through the Internet. It contains new and innovative functionalities in the area of distance education. *Cyberphysique* has been conceived to keep up compatibility with the evolution of new technologies of information and communication. New technologies will be integrated by a «plug and play» strategy which, in turn, will facilitate its adaptation to upcoming technological changes. The costs associated to updating will therefore be kept to a minimum and will be limited to the interfacing between the system and the technology involved.

3. Conclusion

The proposed multimedia distance learning environment wishes to facilitate the student’s learning process. It has therefore been conceived in such a way as to offer functionalities that take into account certain learning strategies. *Cyberphysique* is intended to build the student’s profiles and adapt on it the learning process, the pedagogical activities and the feedback to be gave. The interface is created to make the use of the system as easy as possible.

By offering a learning environment which is adapted to the learner, highly compatible with the ever-changing technology and favoring the creation of content using authoring-environment, *Cyberphysique* can be described as a Distance Interactive Learning
Environment (DILE) in which new pedagogical concepts (such as collaborative learning, metacognition, …) are integrated in order to facilitate learning.

4. References


