Adaptive and Collaborative Learning Using netUniversity, an interoperable LMS/LCMS

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1. Introduction

Having a dynamic content has been a major advantage of hypermedia but this facility has soon become a major inconvenient. It is proved that user can be disoriented in the hyperspace unless a customized orientation is provided.

The solution was to adapt knowledge presentation to learner's profile. This would guide him through the hyperspace and help him build the adequate pedagogical content.

Generally, the purpose of adaptability is to hide different parts of learning content, to make them inaccessible to user, as they are considered inappropriate for a certain phase of the learning process. For example, specific details can be hidden from a user which doesn't possess a lot of knowledge on a given topic. On the contrary, supplementary explanations can be provided to beginners.

Moreover, certain categories of users can receive supplementary information dedicated to them. This method is used by other systems as MetaDoc, KN-AHS, Item/IP and EPIAM. One variant of this method consists in hiding information which doesn't fit well with the current purpose of the study.

It is also possible to define prerequisites. Before presenting a chapter, the system inserts the explanation of all the necessary concepts that should be known by the user in order to understand the content of the chapter.

Moreover, teacher can conceive different representations of the same information for different types of students. In fact he can create a diversity of content's pages presenting information in different way. From all this pages, the one that best fits the learner profile will be displayed.

Content's adaptation is an exceptional and useful way to present multimedia content adapted to user's profile. In the same context, Brusilovsky considers adaptive hypermedia very useful when the system is used by persons having distinct levels of knowledge or understanding and having different goals (Brusilovsky 2003).

This is the reason which leads researchers to design systems that support the approach founded on self-regulated learning (Schunk & Zimmerman 1997).

In fact, among the drawbacks of classical education, we note that the student has the role of the receiver and the teacher is his only resource of learning. For this reason, research works are concentrated on the design of systems based on self regulated learning (Schunk &

Zimmerman 1997). This approach allows learner to become self-governing in order to establish objectives and finally to find the best learning method adapted to his needs. Furthermore, the learner holds the main part in self-learning process.

2. netUniversity Platform

Distance learning became easier and more efficient by the use of educational platforms. These integrate systems offering a wide variety of activities in the learning process. Professors are using the platforms in order to control and adjudge student's work (Quenu et al. 2007). They use Learning Content Management Systems (LCMS) to create courses, tests, etc. However, platforms don't offer personalized services; therefore, they don't take in consideration adaptable aspects such as knowledge level, personal interests, motivation degree and learner's objectives.

netUniversity Web portal (<http://tice.utcf.fr:8080/netUniversite>) presents an easy and competitive solution for creating and managing pedagogical content as online courses (hypermedia). It offers a wide diversity (Giacomini et al. 2005) of pedagogical models in order to assure the best adaptation of the course to the chosen pedagogy and learning style.

Fig. 1. Graphical editor for course's structure

netUniversity was conceived for teachers with weak computer skills in order to help them build their own web site (Benmimoun & Trigano 2008). In order to create a course we have to answer to a series of questions prepared by two questionnaires: the pedagogical and the graphical one. The aim of the first questionnaire is to establish the didactical characteristics of the course (Giacomini et al. 2005) and to generate, according to them, the basic structure

of the site without any information in it. The second one tries to establish the HMI details of the future web site. It was proved that in hypermedia systems, an appropriate choice of the graphical interface, taking in account user's profile, will increase his interest in using the tool. That is why the facility of choosing and modifying the human machine interface represents one of the strongest points of netUniversity, as it allows users to customize their work according to their imagination and personal vision. Once the course generated, the user can start editing the content of the course. This can be done by using different tools that simplify tasks like course creation or internal and external import of resources.

In fact, netUniversity contains a module for course administration, an editor of course content, a collaborative learning generator, an interoperability system and a course structure generator, based on the IMS-Learning Design (Giacomini et al. 2005).

2.1 netUniversity and IMS-Learning Design

IMS-LD (<http://imsglobal.org>) is a standard and a modeling language for pedagogical content representation. The main concept is the concept of learning unit (Koper 2001), an abstract term which defines a course, a lesson, etc. IMS-LD (Burgos et al 2005) proposes to organize pedagogical content in a tree structure containing the pedagogical elements, such as learning design (Emin 2008) (having as elements: method and component), act, role (learner or staff), learning activity, support activity, activity structure, learning environment, items, etc.

Learning Design specifies three levels of implementation and compliance, as follows (Rey-López & Brusilovsky 2008): level A (static) included in level B (dynamic) and the last one also included in the level C (notification). Level A contains the core vocabulary and allows the construction of a static learning content, while level B adds to A properties and conditions enabling personalization and more elaborate sequencing, thus more flexibility. Using level B we can take into account the adaptable dynamic evolution of a certain course. Properties are variables used by the system to save the information related to a person or a group of persons. Level C enables message passing from a role or addition of new activities associated to a role, consequence of notifications during the learning process.

As a result, using the IMS-LD standard, netUniversity gathers the following facilities:

- Generation of the base structure for educational Web sites,
- Edition of the course content inside the previously generated structure,
- Visualization and participation to course using the integrated navigator.
- Content adaptation according to the cognitive level of the student
- Generation of collaborative learning tools (Chat, Forum, wiki, ..)
- Interoperability of the course structure and reusability of the content

2.2 Self-Regulated learning

Thoughts in (Azevedo & Cromley 2004) showed that learners find difficulties with self regulation using hypermedia. Indeed, they do not have adequate self regulation strategies making them face difficulties and obstacles in learning with the hypermedia. Combination of high skills of self regulation and of learning motivation determines to which level learners could exploit the hypermedia. This point of view was supported by (Rouet 1992) who added that it is essential that the learner fixes, first, task goals that he wishes to realize before even starting learning activity. He needs, in addition, explicit complementary assistance. Indeed, hypermedia could induce an effective cognitive process and a self regulated learning

behavior, only if it is integrated in an educational context supported by well defined goals and an active presence of assistance. This assistance could be present in the form of a tutor whose mission is to help the learners to become self regulated in their learning. Hypermedia remains ineffective, if learners do not control and direct their process learning.

Schunk and Zimmerman have proved in their research that this type of learning is widely influenced by emotions, cognition processes and a specific behavior directed against the accomplishment of a task (Zimmerman 2008). The effects of social and instructional variables on cognition, learning, self-regulation and motivation are taken into account. Achieving a goal takes motivation, self-confidence and self-awareness of personal competence as well as capacity to find the necessary information, to make it accessible and, if it is the case, to find a method to overcome the difficulties that may appear. Indeed, according to Zimmermann (Zimmerman 2008), learners implement a process of self-regulation only when they are “meta-cognitively, motivationally and behaviorally active participants in their learning processes”. Self Regulated Learning represents a recent research field of the last two decades and it became possible due to the accelerated development of TELE (Technology Enhanced Learning Environments) which allows creation of learning environments based on modern technologies.

2.3 Adapting Content According to the Student's Cognitive Level

In an educational software or system it is very important to find answers to some fundamental questions such as: how to check if the user has definitely understood all the important concepts, and how well the software is adapted to the cognitive and epistemological characteristics of the student. (Rey-López & Brusilovsky 2008)

Fig. 2. Pedagogic scenario modeling

It is also necessary, in order to attain the purpose of study, that the system gives user a feedback regarding what he really understood and what he believes he understood. (Burgos et al 2005)

Besides, helping the learner to keep clear in his mind the objectives of his study and giving the teacher the possibility to evaluate him, will increase the quality of education and will guarantee the attainment of his purposes.

One of the objectives of our research is to propose a group of models for structuring pedagogical activities in order to make them adaptive in the context of hypermedia. In fact, we try to adapt the course content and the interactive support to the cognitive level of the student. Implementing level B (adaptive) of IMS LD allows teacher to edit his own pedagogical scenarios (Figure 2) using the following two concepts: properties and conditions. By this, the teacher can draw the ideal learning process for the students. These scenarios allow to adapt the displayed learning content according to intellectual and cognitive level of learners.

According to Merrill (Merrill 2002), learning becomes easier when students solve the exercises and problems progressively. Merrill suggests that: «[...]Through a progression of increasingly complex problems the students' skills gradually improve until they are able to solve complex problems. [...]». As a result, the learning path the student is going to follow depends on the obtained results.

In fact, adaptation is made further according to a test which can provide us with information concerning the epistemological level of learner.

This knowledge allows later to redirect student to a specific node in the pedagogical tree of the scenario already created by the teacher.

According to the results of his test, the student is automatically oriented to a web page which best fits to its knowledge and to his intellectual level. This permits to create an educational hypermedia adapted to the profile and knowledge level of each learner. (Rey-López & Brusilovsky 2008)

We mention that the adaptation mechanism of this tool has some drawbacks. In fact, adaptation is only based on test results, which is not enough to decide the future learning path for the student.

For this reason, our goal is to create an adaptive hypermedia based on several analysis methods such as cognitive analysis or monitoring systems, which draw the steps of the learning process of the student. This information is going to be exploited later in order to predict the next stages of his progression

2.4 Interoperability and Reusability of Web-based Learning Content

From a technical point of view, the progress of Internet technology makes elearning resources widely available. As a result of this evolution arise the need to create a communication structure based on standards that make access to information universal.

Specifications and standards for the formalization of learning content descriptions, such as SCORM, were developed, on one hand, to simplify pedagogical content search and on the other hand to reduce the time of creating learning equipment design by the reuse of existent pedagogical resources.

Today's education faces a big evolution using information and communication technologies, as well as a big number of tools which allows the creation and the administration of pedagogical contents, such as Blackboard, WebCT, Moodle or Dokeos.

For this reason, we can observe a quick increase of works and researches developing elearning standards and specifications as IMS (LD-Learning Design, LIP- Learner Information Package, CP- Content Packaging, Simple Sequencing, ePortfolio) IEEE LTSC (LOM – Learning Object Metadata), ADL (SCORM – Sharable Courseware Object Reference Model), etc.

In the same context, we focus our work on the management and exploitation of educational content by establishing a mechanism for export and import, in three formats (Fig) .2): IMS LD, SCORM and SCENARI (<http://scenari-platform.org/>), which allows:

- A course generated by netUniversity to be used by others applications that don't have the same structure.
- A course compatible to IMS LD to be used by applications supporting SCORM and vice-versa.
- A course compatible to IMS LD or SCORM to be used by SCENARI application.

Fig. 3. Interoperability of netUniversity with different tools

For this reason, we work on the creation of course structure transformation mechanism (Figure 4) that guaranties the reusability and extensibility of the educative contents, as well as, the interoperability of the hypermedia systems.

Fig. 4. Course structure transformation

Briefly, this mechanism is based on XML and XSLT technologies. In fact, course transformation begins with XML structure analysis and organization. Next, using the XSLT technology we convert each XML tag according to both schema structures (source and result). Conversion will be validated at the beginning of the third phase to assure course integrity.

2.5 Collaborative Learning

Learning in group means first of all "to act" and "to communicate". Collaborative study is any learning activity accomplished by a group of students having a common purpose and each of them being a source of information, motivation, interaction, and mutual help. Each one is benefiting of the contribution of the others (Henri et al. 2001).

In fact, collaborative learning gives students a big flexibility of time and place (stimulating self-government and reflection) as well as an excellent asynchronous interaction (source of motivation, mutual help, critical mind, and synthesis). We find this idea at Harasim (Harasim 1989) which considers that the collective nature of 'computer conferencing' can be the most fundamental and critical element underlying the elaboration of theory as well as its design and implementation of online educative activities. From this perspective, the online collaborative learning is the most important pedagogic assignment of online education.

In the incontestable Salomon's logic (Salomon 2000), teaching an online learning without giving learners the opportunity to take advantage of his most "fundamental element", reduces the interest in learning and hypermedia system that supports it. This means that online education must have at least a minimum of collaborative study. For this reason, we integrated many systems to generate a set of communication and document share tools as: Chat, Forum, Wiki, Blog. This, can improve the quality of education, and put the light on the interest of collaborative learning. In fact, we have integrated a set of mechanisms and free generators (FreeChat and PhpBB) which allows to create synchronous and asynchronous communication tools.

Using these mechanisms, the teacher will be able to create a 'Chat' and a 'Forum' as part of each course. This gives learners the possibility to communicate between themselves, to obtain information and to clarify the ambiguities. Furthermore, working using collaborative tools can reinforce the social aspect and also documents and knowledge sharing aspect.

Also we have integrated mechanisms to generate wikis and blogs. In fact, a wiki is a collaborative model for writing and publishing web documents. It allows all members from the same group to edit the page they are reading. In addition, the history of the successive modifications of the page is always visible when editing. A blog consists in a periodic contribution reporting accomplished tasks, it is a space for saving and uploading documents. Each member of the group accomplishes a task after another and updates each time blog's content according to his specific task.

Using these tools, the teacher has the possibility to add one or more instances of collaborative tools in his course. Working in several small and independent groups can be done by just subscribing each group into a specific wiki or blog.

3. Exchanging Experience

During the last two years, we have developed on two projects using netUniversity platform. They implement the self-regulated learning approach. In view of the very positive results we registered, we will briefly present them in this section.

3.1 eDalgo Project

The project was meant to be developed during two years in collaboration with other universities and with the financial support of the AUF (Agence Universitaire de la Francophonie) (<http://www.auf.org>). It has been developed in a partnership between four francophone countries: Romania, France, Tunisia and Algeria (respectively, University of Craiova, Technology University of Compiègne, Institute of Higher Commercial Studies of Carthage and National Institute of Informatics of Algiers).

The objective (Benmimoun et al. 2008) was to create of an interactive online francophone hypermedia course (using French as a language) which engages the student in a self regulated learning process and having the privileges of an adaptive system that can be adjusted dynamically to the user needs. (Giacomini et al. 2005)

The course is conceived as a web site containing all characteristics of a self-regulated eLearning system. Among the most important of these components, we mention: theoretical parts, the games and simulations, and most of all, interactive exercises which take into account emotional, cognitive and behavioral aspects.

The realization of the interactive course « eDalgo » which represents the main part of our project is made using the netUniversity platform.

3.2 Vanupiets Project

The VANUPIETS project (Quenu et al. 2007) has been financed for a period of two years by a French regional program, called Educapole. This program aimed to develop new information and communication technologies dedicated to training activities.

The objective of the project was to validate the netUniversity portal (Giacomini et al. 2005) . It consists in evaluating its usability and to define its improvement possibilities, in regard to user practices and needs. The goal established for the new version of this tool was to focus on user.

Following its objectives we had, first, to experiment this portal in different learning environments. A second task was to evaluate it in higher educational contexts.

The first phase has been realized in collaboration with a teacher of the UPJV university, who had used this portal for a hybrid course (thought in class and at distance). After receiving feedbacks of this first experiment, a second phase had consisted in the extension of the experiment to other courses and other teachers of the UPJV and the ULCO universities.

4. Conclusion

This paper tied to give an insight into the netUniversity web portal, which presents an easy and competitive solution for creating and managing pedagogical content as online courses. Based on the IMS-Learning Design, netUniversity permits to adapt the learning content according to intellectual and cognitive level of learners. It supports self-regulated learning,

which stimulates the learner to become self-governing, to establish his objectives and to find the best learning method adapted to his needs.

In addition, it guaranties the reusability of the educative contents and the interoperability of the hypermedia systems.

netUniversity allows to create a diversity of collaborative learning tools which improve the education process.

Our future perspective is to improve the adaptive system based on several analysis methods such as cognitive analysis which draw the steps of the learning process of the student.

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