A virtual learning system to improve technical education in developing countries

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Abstract
The educational sector in Europe is oriented to a process of radical restructuring with the aim of obtaining integration among degrees, a better education quality and more chances to improve and update the knowledge. This article introduces a virtual learning method (WINDS) for technical studies through the usage of the new technologies. WINDS-Web based intelligent design system is the result of a RT&D Project from the IST Fifth Framework Work Programme with the aim to reform education by developing new curricular and pedagogical models. Experiences gained during the experimentation phase on a real world university teaching scenario are also reported in this paper. First results encourage involving this learning methodology to the current University studies. In developing countries with reduced resources Virtual Learning Systems offer an opportunity but, at the same time, they need an investment in the technical and administrative infrastructure.

Keywords
Teaching/learning strategies, virtual university, WINDS.

INTRODUCTION

The main objective of WINDS (Web-based Intelligent Design and Tutoring System) project was to contribute to the reorganization of the pedagogical, cultural and functional aspects of design education at the university level. WINDS project was oriented to fulfil the requirements of Flexible University, defining new approaches to design teaching, implementing flexible learning services for university education and constructing large scale experiments in order to promote cultural integration.

WINDS project has developed a networked design tutoring environment which provides the typical university’s educational resources like administration office, courses, teachers, reviews, cooperation, libraries and so on. The system gives access to services through the Internet by means of shared instruments, web-browsers and commercial CAD systems. It promotes cooperation between students (peer tutoring) and between students and teachers (remote tutoring) by means of groupware tools [Fitzgerald 1985]. The system can also autonomously assist students during design courses by
means of expert systems and intelligent tutoring, which are based on well established pedagogical models. In this paper, our experiences using WINDS platform will be described. Experiences gained during the experimentation phase on a real world university teaching scenario (in the Technical University of Catalonia) will be also reported in this paper.

Fig. 1 WINDS System entry.

DESCRIPTION OF THE WINDS SYSTEM

WINDS platform

The WINDS platform (developed inside the Consortium by FIT- Fraunhofer Institute for Applied Information Technology) is based in an Authoring and Learning Environment (ALE) and it is aimed to design teaching. WINDS platform includes contributions from twenty one European universities from 10 different countries, structured in three departments: Department of Architectural Design, Department of Environmental and Building Technology and Department of Construction Management. All these courses can be accessed in http://winds.gmd.de (see figure 1).

Learning Environment

Courses in WINDS platform are made up of Learning Objects, which can be defined as files aimed to structure the learning material. Learning Objects can be classified in three different topics: Course Units, Learning Units and Learning Elements. Course Units are top-level elements that only have subunits. Learning Units configure and structure the content of a Course Unit. Learning Elements are the basic information fragments of the platform and they can be classified into three subgroups: paragraphs (including the contents of the course), exercises with the practical part of each course and true of false tests and multiple choice tests to asses the acquired knowledge. The variety of Learning Elements is huge (see figure 2), allowing a better adjustment of the form to the content. For example, we can find different kind of paragraphs like simple text paragraphs, picture paragraphs and movie paragraphs. Multiple choice tests and true of false tests can also be created using Learning Elements.
To enable the maximum reusability of the information, each Learning Object has an associated metadata (see Authoring Environment for further details). Furthermore, all the Learning Objects of a course are linked by an Index Terms defined by the author to unify definitions and extend information of each course.

Fig. 2 Learning Elements in WINDS platform.

Index Terms

Index Terms provide means to inter-relate heterogeneous course contents and to find individualized paths through learning materials. Index Terms includes all the relevant concepts contained in all types of Learning Objects. Main concepts are defined and connected (by expressions like “is a”, “is a part of”, “related to” …) to another concepts defined in the Index Term. These relations can be also expressed in a graphic way. Index Terms also allow finding occurrences inside the Learning Objects, which are displayed highlighted (see figure 3). Index relationships are the base of WINDS reasoning processes.

Fig. 3 Index Terms in WINDS platform.
Cover Story

The basic approach is task based teaching and can be defined as follows. The competence set, taken as the backbone of the teaching outline, can be arranged around a general design task that is to be performed by the learner [Schank, 1992]. WINDS calls this task the Course Cover Story. The teacher creates a cover story for the course, assigning a challenge to the students that embody the output of the professional competence to which the course is targeted. Most of the training will then be focused on providing the trainee with the information and tools he needs to achieve the goal. This is to say that competence analysis greatly helps the teacher in designing goal-oriented learning courses, rather than expository teaching ones.

Collaborative Space

Collaborative space is an application software that integrates work on a single project by several concurrent users at separated workstations. In WINDS project, the Collaborative Space is established on a BSCW (Basic Support for Cooperative Work) system (developed by Fraunhofer FIT and OrbiTeam Software GmbH) and consists on the virtual space where to establish contact among students, students and teachers and teachers. Collaborative Space enables users with accesses to the server to view, upload and download documents, post messages, … and therefore the teacher has the possibility to follow the progress of student’s works. Collaborative Space can be directly accessed from WINDS Learning Environment. Another cooperation facility in WINDS platform is the possibility to create private and public annotations related to the whole course or to a particular Learning Object. Users can also start discussions or contribute to the existing ones, which can be related to the whole course or to a particular Learning Object [Kumar et al. (1998)].

Collaborate Software
The platform also includes an interface called ‘Collaborate’ (developed by Nemetscheck), which allows the interaction teacher-students in a fast, easy and dynamic way [Taylor and Walford (1978)]. It allows a total interactivity and also in real time.

**Authoring Environment**

The authoring interface gives an overview of all courses authored. In the Content Catalogue, all the learning elements created by the author can be listed as well as the index term, which defines and connect the main concepts exposed in the Learning Elements. Documents, which are supplementary sources of information relevant to the course, can also be registered in the authoring environment.

When creating a new Learning Object, the following forms are provided:

- **Edit** to add, move, copy, disconnect or delete Learning Objects in the structure and modify its content.
- **View** to display the learning objects in the same way like students will see them in the Learning Environment.
- **Terms** to show terms entries highlighted and displaying the corresponding term descriptions and relations on demand.
- **Relation** to specify prerequisites to this Learning Object.
- **Meta data** to provide information under six categories related to Learning Objects. The General category includes general information like content description or key words that describes the Learning Object as a whole. The Lifecycle category includes the features related to the history and current state of this Learning Object and those that affect this Learning Object during its evolution. The Technical category includes the technical requirements and characteristics of the Learning Object, like format, size, location,... The Requirements category states groups the intellectual property rights and conditions of use for the Learning Object. Finally, the Skills category includes information related to which competencies will contribute to acquire this Learning Object.
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- **Authors to specify each Learning Object authorship**
- **Annotations to create a new annotation about the current Learning Object.**
- **Discussions to start discussion about the content of the current Learning Object.**

Fig. 5 Authoring environment in WINDS platform.
Tutoring Environment

In the Tutoring Environment, teacher can see the list of students enrolled in the course and the state of their progress (see figure 6). It is possible to view which learning objects have been visited and if the student has correctly answered the true/false tests and multiple choice tests. The system also compiles detailed information about the total number of learning objects visited by the student, the number of connections to the WINDS platform and its mean and total duration.

VALIDATION OF WINDS PLATFORM

The role of evaluation is fundamental in the field of a project such as WINDS as it represents an instrument that is indispensable in the project’s validation process and in the certification of its didactic effectiveness.

Validation of WINDS platform was carried out in several universities at the end of year 2003. Two basic domains of experimentation were stated for the validation of the WINDS platform: External comparison (which aimed to compare WINDS courses with traditional courses) and Inner functioning, which was focused on assessing the quality of the WINDS platform.

In the Technical University of Catalonia (UPC), the experimentation was proposed to the students at the beginning of the academic official course (2003-2004). Among the requested requirements to participate in the experiment were stressed the necessity of an internet position from home or alternatively a position of internet available inside the faculty and with adequate software support adapted to work on line. Furthermore was stressed the requirement of a sufficient knowledge of the English language. Two groups of students were formed: the traditional group (made up of 6 students) and the WINDS group (made up of 8 students). The experiment required that during the same period the WINDS group worked on line while the students of the regular academic course developed the same topic in traditional lessons. During the experimentation period the WINDS group of students did not contact colleagues and teachers. All the communication was managed through the winds resources (ALE, BSCW, Collaborate).

Fig. 6  Tutoring environment in WINDS platform.
Fig. 7 Evaluation of the inner functioning of WINDS platform in the Technical University of Catalonia.

Quality Assessment of WINDS platform

Students from UPC focused on three lessons of the course “Quality, safety and environmental management” and on the Cover Story, which was shortened and adapted to the particularities of the experimentation phase. At the end of the period of study, corresponding to an equivalent amount in time of three didactic units, all the students answered the Multiple Choice Tests and the True or False Tests. In fact, in the tests of WINDS platform it is possible to reiterate the test several times until the right answer is given, so a student can try out the system until the check of the chosen option is fully correct. Therefore, this learning resource offers mayor opportunities of learning to the WINDS students compared with other students that can obtain less feedback from a multiple choice test.

After the exposition period, all UPC students developed in pairs the graphic exercise exposed in the Cover Story. WINDS group used the Collaborative Space in order to develop and deliver its graphic exercise. Exercises from both groups were corrected by an external teacher who was unable to distinguish between the traditional group and the WINDS group. After evaluating and ranking in a scale of ten numerical degrees (from 1 to 10) the graphic exercises, the evaluator concluded that no difference can emerge from the blind evaluation. Therefore we can conclude that the learning output of WINDS do not differ from the one of traditional courses.

In order to assess the inner functioning of the WINDS platform, WINDS students from UPC were asked to complete a questionnaire (developed inside the Consortium project) based on 29 items related to Communication, Content, Functionality, Usability and Accessibility features. In each item
of the questionnaire the user had to express his agreement on a given statement, using a 5 point scale. Results obtained in the Technical University of Catalonia are presented in figure 7.

Analyzing the results obtained from the questionnaires filled by WINDS students in the Technical University of Catalonia we can conclude that the information content of WINDS is relevant, complete and reliable. In addition and according to WINDS users, information design is appropriate. Functionality features sums up all the aspects concerning the interaction between WINDS and its end-users. As functionality have obtained in the questionnaires a score of 3.6 we can conclude that WINDS functions are adequate to reach WINDS educational goals. Attending to the usability, WINDS platform has also been well assessed by WINDS students. This means that this system allows students to reach their educational goals, with no much efforts and time devoted to this task. According to WINDS end users, accessibility is at the time the poorest feature in the platform. Problems in connecting with WINDS server are the most alleged reasons by the students.

CONCLUSIONS

In this paper, main characteristics of WINDS System, which provides a new methodological approach to design teaching, have been exposed. The experimentation phase allowed authors to conclude that it is possible to use web platforms for Virtual Learning of design courses as its didactic effectiveness has been successfully tested in the Technical University of Catalonia.

First results encourage involving this learning methodology to the current University studies for developing countries with reduced resources as nowadays knowledge is a prerequisite for economic growth and development. The speed by which new knowledge, new practices and new products appear in the market makes necessary a personal commitment to learning throughout our whole lifetime. Virtual learning will be a fundamental learning strategy for initial education, as well as for updating of the populations’ knowledge and skills in the economy of the Information age.

Virtual Learning Systems such as WINDS offer to developing countries both an opportunity and a challenge because it would be misleading to suggest the distance education can be used in developing countries without investing in the technical and administrative infrastructure.

REFERENCES

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