DISTRIBUTED LEARNING PERSPECTIVES

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Abstract: Today's competitive economic and social environment asks for high educational expertise. There is a tremendous demand for education and training, and many countries fail to meet such requirements. Overall, there is a discrepancy between the need of the economy and society nowadays and what education manages to provide. Moreover, with a rapid growth of educational content, providing a qualitative learning experience is not an easy task.
Technology expansion can augment traditional, instructor-centered learning. Distributed Learning Environments successfully combine campus-based teaching with computer-oriented, e-Learning facilities, towards the delivery of qualitative education. An attempt to setting up a qualitative learning environment in an academic European network is ViReC (Virtual Resource Center) e-Initiative. Providing a collaborative, time and location-independent, and interactive mean of learning represents the key to an increased competitiveness for high-level education institutions.

JEL classification: I20, I21, I23, I25

Key words: distributed learning; e-learning; education; virtual resources; virtual web portal

1. INTRODUCTION

In the competitive economic, social and educational context nowadays, there is a high demand for educational expertise and many European countries fail to meet such requirements. Overall, there is a mismatch between what education provides and what society and economy needs in the sense that there exist a discrepancy between what is taught in schools and what is needed in the workplace. One solution to reduce this gap is to adopt a collaborative, time and location-independent, and interactive mean of learning. Providing a Distributed Learning Environment (DLE) is essential to education provision, especially in high-level educational institutes. Each institute aiming at high-level, student-centred education delivery needs to develop a DLE build-up strategy. The strategy of adopting such a platform is the success key in today's competitive educational environment.

At a closer look at the global e-learning today, we may deduce that e-learning is quickly becoming an industry. With a rapid growth of educational content, providing a qualitative learning experience is not an easy task. Technology expansion has the

potential to augment traditional, instructor-centred learning. DLEs successfully combine campus-based teaching with computer-oriented, e-Learning facilities, towards the delivery of qualitative education. However, the advantages of the technology's expansion nowadays are not fully exploited. Moreover, the DLE needs to be regarded as an extension of traditional, classroom-oriented education provision and not as it's substitute.

A former project - ViReC (Virtual Resource Center) aims at setting up a qualitative learning environment in an academic European network. ViReC Web portal targets regular students from European universities, students with locomotors handicap, individuals who seek retraining, companies who seek personnel retraining, companies specialized in personnel retraining, academic staff and teachers/trainers acting in the public/private sector. Not only, the portal represents the access point to a large collection of resources: textbook materials, tutorials and exercises, but the novelty of the DLE system consists in the synchronous section which provides facilities for remote live presentations and experiments based on real equipment that is accessible, configurable and testable over the Internet. ViReC serves as basis of deducting helpful information on the development of DLEs. A careful analysis of ViReC can provide insights into three directions: user (namely, the student), instructor and administration. Moreover, outcomes of ViReC permit dissemination on issues as distance learning, online courses and instructional materials, interactive multimedia textbooks, access to remote systems, synchronous and asynchronous group communications, experiential learning, course and content management, online testing and assessment. ViReC covers subjects in Computer Engineering; however, its applicability can be easily extended to any area of study.

The paper synthesizes past and current approaches on DLE and on its variations: distance learning, e-Learning and virtual learning and presents the results of the joint efforts of universities and high-education institutes across Europe in developing ViReC project. ViReC Web Portal is an important component of a DLE and offers open access to a large collection of differently located resource, including virtual laboratories. Section 2 provides an overview on various distance education forms and summarizes DLEs current approaches. In Section 3, the ViReC platform is described with focus on the architecture, functionality and actors and finally, the results of the project are discussed in Section 4.

2. BACKGROUND

2.1 Distance Education, e-Learning and Distributed Learning

Before delving into practical details of the DLE, we need to provide a clear understanding of the terminology. Practice and theory reveal three main forms of distance education that support multiple variations: distance learning, e-learning and distributed learning. We need to distinguish between the three concepts and for that purpose a concise definition is worth being formulated.

Literature attests that distance learning is the first form of non-conventional education in history that overcomes time and space barriers. There have been traces of distance education since two centuries before – Peraton (1981), Simonson (2000), Palloff (2001), Spector (2008), Moore (2010). Ever since, it was foreseen that the number of students studying at distance will overcome the number of classroom

students – Simonson (2000). In time, distance learning has become a familiar term and "has managed very well without any theory" – Peraton (1981). A common understanding matches distance learning to the ability of providing learning facilities to geographically distant students. Over the years, distance learning has suffered various transformations that lead to variations as: distributed learning, online learning, e-Learning, technology-mediated learning, online collaborative learning, virtual learning, Web-based learning, etc. Moore (2010), Conrad (2006).

Nichols arises and discusses ten hypotheses or fundamental principles for e-learning – Nichols (2003). In theory, e-learning "is a means of implementing education that can be applied within varying education models and educational philosophies" - Nichols (2003), while in practice e-learning is often regarded as educational content hosted on a website. But, e-learning "is a multi-faceted and complex area" – Conole (2006). According to Conole (2006), e-learning "is the term most commonly used to represent the broader domain of development and research activities on the application of technologies to education".

Distributed learning is another successor of distance learning, hybrid in its nature since it "combines the most advanced forms of distance learning technologies with aspects of conventional, campus-based education" – Matheos (2004). Moore et. al conducted an elaborated analysis in order to provide a better understanding upon distributed learning – Moore (2010).

2.2 Distributed Learning Environments

The support material of distributed learning vary from plain textbook materials to multimedia presentations, live courses and laboratories, and even much more sophisticated electronic technologies such as intelligent tutoring system and computer-based training – Capuano (2006), Wisher (2004). Therefore, an appropriate platform needs to incorporate as many features as possible in order to guarantee the success of a qualitative learning experience delivery. Another success factor is adopting a user-centred approach: "the learner support must be an integral component throughout the development and delivery of distributed learning" – Matheos (2004). These arguments lead to an appropriate definition of DLE, proposed by Bates and Mingle: "A distributed learning environment is a learner-centered approach to education, which integrates a number of technologies to enable opportunities for activities and interaction in both asynchronous and real-time modes. The model is based on blending a choice of appropriate technologies with aspects of campus-based delivery, open learning systems and distance education" – Bates (1997). Lessons learned and best practices on the delivery of distance education are also discussed by Palloff and Pratt (2001).

A DLE is the tool which enables the delivery of distance learning. It represents a complex topic which regards multiple issues. In the development of DLEs, technology is a powerful argument. However, pedagogy is a critical factor too and "there is always the need to keep the focus on learning, carefully selecting the technology to support the pedagogy" – Matheos (2004). Besides the pedagogical issues, the collaborative aspects of a DLE are often ignored, with lots of focus on the content delivery – Capuano (2006). The
communication pillar for cooperation in this area is critical and requires great care for different socio-cultural contexts, values and expectations – Gunawardena (2008).

A current, challenging aspect of DLEs is the Virtual Learning Environment (VLE). VLE is a software solution that enhances computer-based distance learning. VLEs integrate heterogeneous technologies and multiple pedagogical approaches, they are not restricted to distance education and most virtual environments overlap with physical environments – Dillenbourg (2000). The particularities of virtual labs are that they manage to include real experiments and to incorporate scientific methods. Although, beneficial laboratory work has been asserted several times in literature – Johnson (2009), Bryant (1987), virtual laboratories manage to overcome multiple challenges attracted by the realtime labs. Time dependencies, space constraints, hazards, resource sharing, traveling costs, equipment acquisition, set-up and maintenance costs are few of the issues solved by virtual labs which lead to productivity enhancements.

3. THE VIREC E-INITIATIVE

The project is oriented towards setting up a qualitative distributed learning environment in an academic European network environment and arising awareness of the impact of ODL and the use of ICT in education. The project spans universities and research centres across Europe. Among the participants, there are University of Craiova, Romania, which is the coordinating institution, IPA Automation Engineering Institute, Romania, University of Applied Sciences, Regensburg, Germany, University of Duisburg-Essen, Germany, Institut Arbeit und Technik, Gelsenkirchen, Germany, University of Limerick, Ireland and Technological Educational Institute of Piraeus, Greece. The goal is to develop innovative practices and services in distributed education by implementing a collaborative DLE.

VWP provides open access to a large collection of differently located, educational resources, to a vast instructional support and enables real-time experiments with real equipment that is accessible, configurable and testable over Internet, by means of reservation. Moreover, ViReC enables assessment tracking (see Figure no. 1). According to Allen (1998), assessment is a key factor in a successful learning process: "without assessment, there is no quantitative measure of student performance or effectiveness of teaching".

The DLE includes instructional materials developed using multimedia technologies: textbooks, live presentations, tutorials, quizzes, simulators for laboratory exercises implemented as Java applets and exercises on real equipment. Among the challenging contributions of the platform is the creation of virtual laboratories. By means of registration and reservation, remotely exercising on real devices is possible. For that, a reservation system provides remote access to a certain device for only one student at a given time. After the exercise is completed, in order to bring the devices to the original condition, an initialization procedure is automatically launched. The communication between students and teachers is based on several tools such as: videoconference, forum and chat.

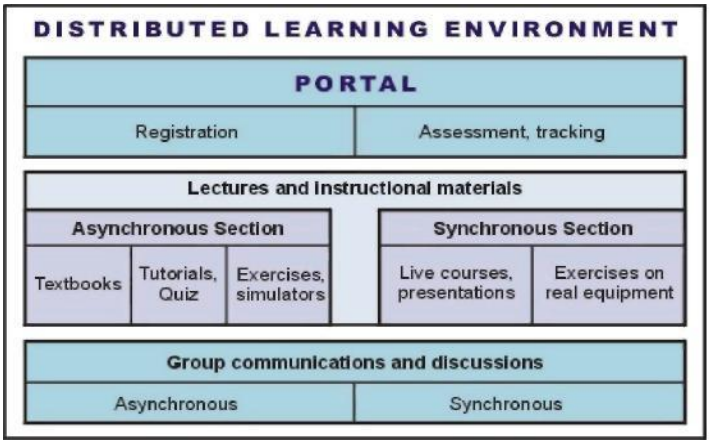

Figure no. 1. ViReC Distributed Learning Environment

3.1 ViReC Web Portal: Architecture and Functionality

In order to analyze ViReC's functionality it is worth regarding the modular structure of the portal. The modules are: Registration, Edit Data, Reservation, Validation and Feedback.

A non-registered visitor has privileges only upon the public section of the portal. The architecture of VWP's enables multiple categorizations and from the visibility point of view we distinguish two sections of the system: public and private. The public section contains pages with general informational content that can be viewed by non-registered visitors of the portal: general information about the VWP, features, information about the private content, etc., while the private section is available only to registered and approved users. The portal permits registration of a new user by filling in a registration form. Registration requires personal information such as: title, name, surname, address, e-mail, telephone, university and enrol number, and also credentials: username, or login name and password for further authentication (Figure no. 2). Inserted information needs to be validated within the Validation module. Once the registration form has been submitted, the personal information is recorded in the database and the status of the user will become "registered". However, a registered user is not allowed to access the private section of the VWP. For that, approval from the administration side is required. The administration processes the registration information and approves the registration. Now, the status of the registered user turns into "approved" and the user may now authenticate. After successful authentication, the user can browse the content of the private section of the portal and register to virtual laboratories. A newly registered user cannot access ViReC's resources until the administrator has granted this right. The private section is restricted to registered, approved and authenticated users. Moreover, an authenticated user can anytime edit their personal data. The Edit-Data module consists in a Web Administration section where authenticated users can view and edit the users database. In addition, users can view the current activity in the portal (authenticated users and brief users' activity logs) and also, see new registered users which were not approved. Registration and Edit Data modules. The Reservation module enables users to practice on real devices for a limited period of time. The module provides a user-interface that allows users book a time period for real-time experiments. A Time Share Reservation Mechanism is

responsible for permitting single user access to the environment. Simultaneous reservation of the same exercise from two different users or simultaneous reservation of two different exercises from the same user is not allowed. Only one user is able to access and work with a piece of equipment during the reserved time. There is a limit of three hours per user per exercise. Time is expressed in user's local time and the VWP and the exercise stations at the participating universities are synchronized. User-Feedback module uses an anonymous report tool where users can provide suggestions related to the ViReC Portal and the DLE. The reports are visible strictly for the Administration. The submission of a new report is automatically signaled in the administration module and, optionally, notified via e-mail.

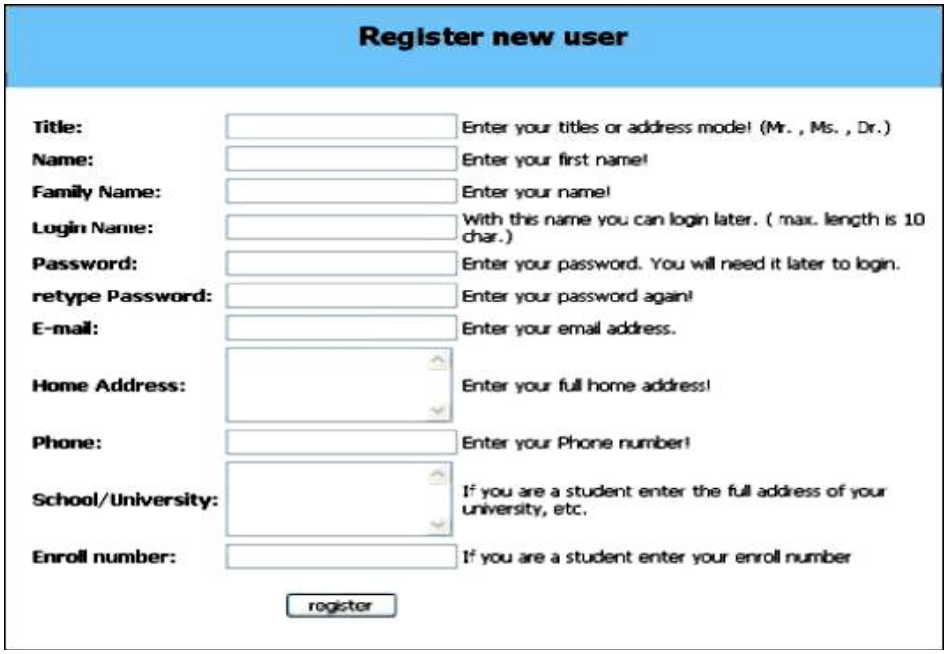

Figure no. 2. New user registration interface

The modular approach of the environment captures the functionality of the system from the user's perspective. Additionally, regarding the platform from the administration point of view provides different insights. The administrator is in charge of the control and monitor of users' activity, namely new users' registrations, awaiting admin's acceptance and users' activity within VWP: log in/log out times, reserved exercises, exercises' results etc. In addition, administration is responsible for the maintenance of the system maintenance. At maintenance times, it is forbidden to reserve and to work on the equipment.

The administration core resides at University of Craiova, Romania. It is their responsibility not only to administrate the server on which the administration system is running, but also to maintain the content in the VWP. The administration of the equipment and lab condition falls under the responsibility of each provider of the correspondent learning resource.

3.2 Roles and Privileges

Aside the user-administration approach, the environment allows a refined classification of roles in the system. Up to now we have regarded the user as a visitor of the portal. This is mainly the student. In addition, the user can also be content creator – the instructor. In such manner, we distinguish two types of users: student and instructor. Overall, there are three main actors in the system: student, instructor and administrator.

The student can and needs to submit a registration form and register as new user. After registration approval, the student is able to edit personal data and view activity log, fully access resources and reserve classes. In addition, the student can communicate and exchange experience with other students or require instructors' support in public or private chat, and send feedback reports to the administration.

The instructor is only added by the admin. Privileges of instructors include editing of personal data, adding and editing instructional materials, accessing resources, communicating and sending feedback reports. The small description of the materials can be made using HTML for formatting.

Finally, the administrator monitors the entire activity in the system. The main role of the administration is to accept new user, namely to add new instructors and to approve registration forms from the students side. Moreover, the administrator has access to the database, can view usage log and edit instructional material (Figure no. 3).

Figure no. 3. Administrator's monitoring activity interface

4. ACHIEVEMENTS

The platform hosts courses, tutorials and laboratories. The current disciplines are: Network Management, Network Security, Computer Architecture and Database Systems.

A remarkable output of the project is the creation of interactive tutorials. In order to provide a clear understanding of the topic, tutorials combine various multimedia materials: text, pictures, animations and audio. The screen is divided into a theoretical part, where text description is provided and an interactive, visual half, accompanied by audio explanation. In Figure no. 4, there is an example of a routing tutorial – building a dynamic routing table. The tutorial benefits of a high quality implementation based on multimedia technology and a flexible navigation system.

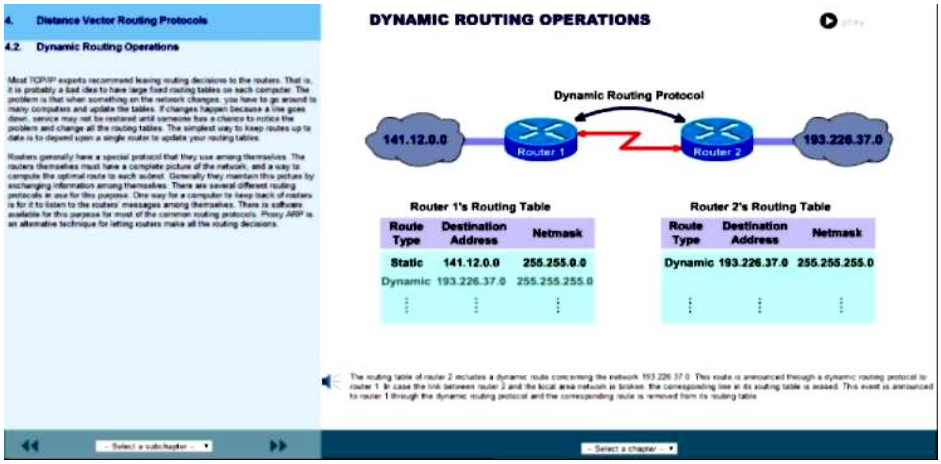

Figure no. 4. Example of a tutorial interface; dynamic routing operations

Working on real equipment by signing in virtual laboratories is another challenging achievement. Resource sharing becomes a reality, improving the utilization of costly equipment. The interface of a virtual lab is depicted in Figure no. 5.

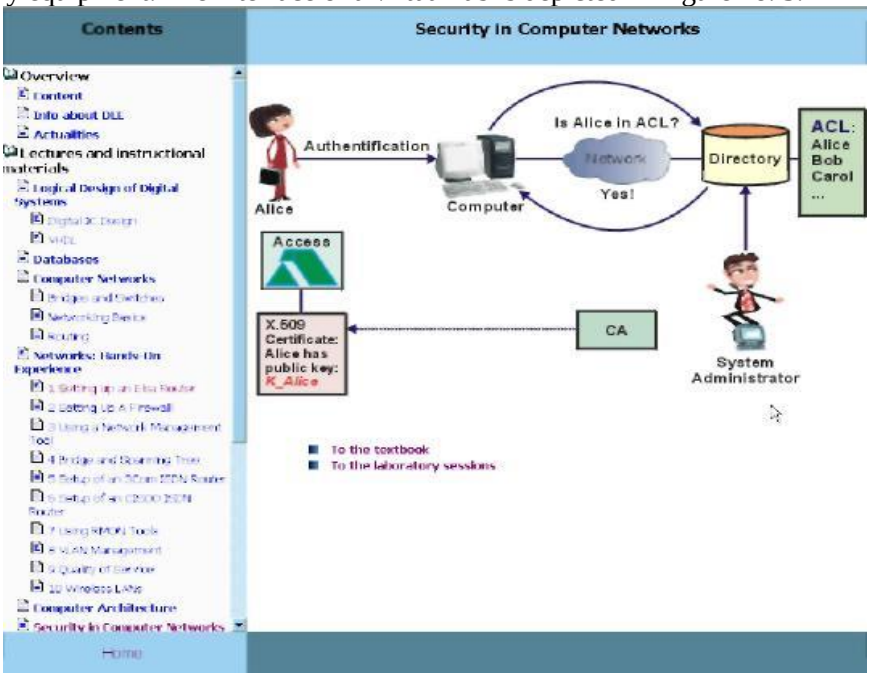

Figure no. 5. Virtual lab in ViReC

The portal hosts Linux operating system and the application uses Java Servlets technology. Servlets technology offers distinct separation between presentation and content. The Web server Tomcat from Apache is the proper solution that implements Servlets technology as it can deal with large amount of client requests without speed or performance penalties. For network threats and attacks simulation we have used virtual machines.

5. CONCLUSIONS

Many of the Web-based DLEs emphasize a user-centric, collaborative learning environment. The teaching and learning process are facilitated since they are not confined by space or time. Students and faculty can access the virtual classroom which is increasingly important to many institutions interested in drawing non-traditional students into their programs. The development of such a platform is relatively quick and easy and the usage is even easier. WWW navigation software nicely integrates access to all types of resources by means of a user-friendly interface. But, the true beauty of the Web lies in the ease of access readily available resources. In addition, human resources are often readily accessible for guidance, allowing enhancing the virtual classroom with the introduction of guest speakers and content experts into your chat areas or discussion groups. "The internet and online communication environments provide stimuli for joint action" – Toprak (2014). Nevertheless, updating and disseminating information is an easy task when it comes to DLEs.

The aim is to make the virtual laboratory a reasonably extensible and reusable platform that can be used collaboratively by large groups of students through a distance-learning format, thereby overcoming several weaknesses of the conventional laboratory-based educational system. However, "most technological substitutes for labs are really just computer-based demonstrations that miss the essential elements of science methodology" – Matheos (2004). In this direction, the virtual laboratory needs to be a computer environment can support different kinds of experiments and analytical requirements. The virtual laboratory has the potential to become a hosting infrastructure for distance learning or training that can align with the needs and practice of curricula programs and industrial attachment scenarios.

Future work can be performed in the challenging aspects of VLEs. An important issue is the student guidance and the student-instructor interaction may easily fail in providing the desired results. Constant improvement should be done on the support material maintenance. Courses, tutorials and other materials need to be constantly updated. Finally, interactivity is a key factor for a successful VLE. Web environments with a reduced level of interactivity may lead to a rapid interest loss on the student's side.

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