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A technological related discussion on the potential of change in education, learning and training

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This paper discuss the supporting role of Information & Communication Technology (ICT) in education activities and puts in context the impact that Computer Supported Cooperative Work (CSCW) can have both in Open and Distance Learning (ODL) and in general education, learning and training.

A project where the author is working in the last two years, the NetLab concept, is presented and used to support the paper positions and serves as the base to propose a roadmap to a virtual university setting.

1. INTRODUCTION

At the end of the century education is on change. In particular, the high levels of students that miss presence classes and display a lack of interest to attend most of the subjects in their higher education is already a common problem for the great majority of european and north american institutions [1].

On-line applications in classroom education, a widespread trend in industrialised societies, can be distinguished from on-line education. The on-line education is now an important trend: in U.S., it has been estimated that 55 per cent of all the 2215 four-year colleges and universities have courses available off-site [2]. Many of the top-rated universities in the U.S. offer on-line degrees and act now as dual-mode education (providing on-campus and distance education) [3]. In Europe, the situation is different and although several universities have their programs the vast majority still lives in the "on-campus age". An early european innovator is the University of Twente that has some on-line programs but as complement to on-campus (see http://www.utwente.nl/masters/mscgen.htm). However on-line learning is extensively incorporated in on-campus post-secondary education in Europe, but few of them offer courses or complete degrees on-line [3].

What are the advantages of off-line campus? The main reasons are the convenience of place and time to learning, may be financially convenient for the student and rewarding for the educational institution [2]. But there is another reason that might contribute to the changing shape of the education needs. In fact, in a recent local inquiry [4] most of students reported that they want to work as soon as possible and they have a strong concern about their future jobs. They also declare that it will be better to pass shorter periods in on-campus activities and longer periods in a working environment. Many more studies reported similar situations where it seems to grow an idea of the uselfulness of longer period degrees: time is playing an important role, as more and more lifelong education is a requirement.

In the traditional school environment, the central mode of learning continues to be face-to-face interaction between teacher and learner, however with a growing influence of asynchronous technological gadgets such as e-mail, web published information, Internet access and the use of CSCW systems and VR techniques. As reported by [3]: "O*n-line classroom applications have not been subject to organised production nor been explored commercially so far. Classroom education, however, can easily make use of instructional material produced for on-line education, in the same way that conventional education has absorbed much of the material prepared for distance education. In this respect, conventional schools and training institutions may constitute one potential customer for on-line education materials."*

Many others reported similar trends, reinforcing however that traditional media still have a significant role, like the reported by [5], where it is expected that programmes and courses will remain fundamentally print based. The share of computer based digital segments and modules will rapidly increase and some figures are presenteded that support this trend (the ratio between print, electronic media and face-to-face sessions will change from 85:0:15 to 69:25:15 by the end of the year 2000).

Based on this context the author proposes a roadmap to a virtual university where content and actual facilities in higher education institutions present a major advantage.

The resources (human, location, facilities and knowledge database) can be used to shift from traditional face-to-face sessions to a broader offer of learning facilities integrating both on-campus and off-campus activities. These new offerings act also as an innovation vector to introduce shorter and more learner-oriented education settings

2.A PROPOSED ROADMAP TO VIRTUAL UNIVERSITY

The Internet has been revealing as one of the great phenomena in what refers to the adoption of new information technologies by non-specialists with an increased number of people who have access to Internet from home [6]. And in schools numbers are also interesting with some U.S. studies showing that over one-half of American public schools reporting [7] insufficient capability in technological infrastructures, but Internet access was possible (1996 figures) from 65% of the schools and 14% of the classrooms [8]. In Portugal [9] and in most european countries similar programs to enhance Internet use in schools are taking place or starting. This will lead to a different kind of student in higher education on the coming years.

From the reading of the different literature it can be listed four general measures that have been taken to introduce networks and connectivity in elementary and secondary schools:

- teacher training for global connections
- introduction of modern computers
- every classroom tied to the global network
- effective software and on-line curricula

The use of the Internet introduces a new way of working with information and even knowledge, creating alternative forms of study and of research with direct impact in the process of Teaching-learning [10] and [11]. Another great potential is the possibility to communicate among students and between professors and students in new forms, starting new ways of collaboration mediated by technology [11].

These possibilities are made feasible by the availability of existent infrastructures: a local area network, the fact that every student has his own laptop computer and the existent network entry points in the classrooms, in [13], a discussion of the Internet impact in the process of Teaching-learning is made.

2.1. The environment: Fernando Pessoa University

University Fernando Pessoa is the merging result of two Institutes in the year of 1994. It is located in Porto, Portugal's second large city. The University (1998 figures) has 4900 students, 380 lecturers and an administrative staff of about 80 people. The students belong to four different departments: Administration Sciences, Communication Sciences, Political and Behavioral Sciences and Science and Technology, with an offering of eighteen courses and three graduations.

The first year students of all courses have a laptop computer as a requirement for admission at the university. The minimal specifications for the laptop computer include the Microsoft Office Pro student licence.

The university network infrastructure is based in LAN connectivity. It started late 1995, with Ethernet 10 Mbps LAN in labs and classrooms, with 170 DHCP entry points and 1 server (Windows NT, Intel box). In 1996 it evolved with LAN segmentation with 300 entry points, including the library. In this phase where started university Intranet services: www, ftp, mail, proxy, mail and news server, with a 64KB WAN ISDN line to Internet. In this phase the network has 5 servers (include two Sun boxes). In 1997 the LAN segmentation continued (with some segments with 100 Mbps), and the number of entry points is now 400. The network has now 10 servers (with Solaris, Linux, and NT).

The actual numbers of laptops computers at Fernando Pessoa are 2300 for students and 100 for teachers. This makes that the actual infrastructure at Fernando Pessoa has coverage of 1 entry point for each 5,75 students or 1 entry point for each 6 laptop owners. Over the years the use of shareware and freeware has increased (consequence of Internet use, from none to almost 65% of total used software); more information can be found in [13].

2.2. The NetLab concept

Every student can connect to the network using their own computer or through the campus facilities. Students will be able to use networked facilities, and set up projects on their area: Advertising, Marketing, Anthropology Studies, Communication, and Business on-line. The massive presence of laptop computers now makes part of the IT infrastructure of the university. This affects in a different way the needs and the use of a Campus Wide Information System - CWIS.

As seen in Figure 1, it is possible to consider the technological infrastructure just as the first layer that can enable the production, communication, change and share of content between students, students and teachers and even between teachers by linking computer resources and their respective contents [14].

In that approach it is possible to have an experimental education lab where innovative situations can be tested. An

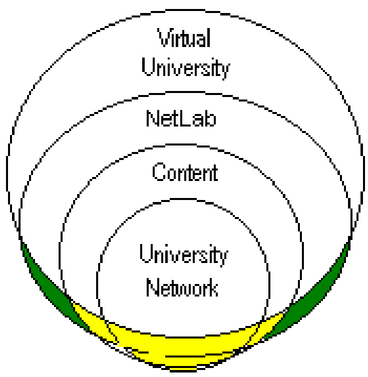

Figure 1 - the NetLab concept

example is the group assessment where three students make an exam: one at the classroom, another in a social location and the third in the library, each one with their functions and communicate between them using the network and its favorite computer tools [15].

The system itself can be a good prototype for a local information society where different people from different courses can interact using a strong digital base for its relationship [16]. One example could be the call for help in student's projects from subjects more related to some courses then others, or initiatives like the ecological interest group, *Geonucleo*, that have their own web pages (http://www.ufp.pt/units/geonucleo/default.html).

The NetLab does not intend to be neither a virtual campus network nor a distance learning environment. It wants to be a local interaction engine that provides a structured approach to services and content generated both by students and professors.

2.3 NetLab contributions

But what is really different in NetLab? First, it is people-centered and not technology oriented; second, the environment where NetLab exists has a strong reinforcement in mobility (with laptops and DHCP network entry points); third, it provides a greater involvement between students and university by sharing of technology investments.

At last, because the network allows the use of tools for information manipulation from classrooms to all spaces of the university (this brings new concepts of multidisciplinary projects; the class that never ends, new forms of interacting between students and between students and teachers and even between teachers).

The NetLab can be seen as a first step to prepare and prototyping on-line material and off-campus on-line courses and train teachers to integrate ICT technologies in the Teaching-learning process. When integrating these goals with the various resources, information technology and adequate organization, the institution can shift to offer on-line degrees off-campus and offering ODL courses as a normal part of its service catalogue. This situation has been defined as corresponding to the ones in reporting as virtual university [17].

Before NetLab layer (figure 1) stays the content layer and the technology itself. First to enter discussion on the technological aspects it is important to discuss the content layer. It is a major advantage for most of the higher education institutions because they constitute the great producers of content material and to have a proper workforce to maintain these materials update and usable. To get the students involvement and even other teachers' involvement, it is necessary to gather content and publish it on-line. An example of multiple content offers is the author's homepage (http://www.ufp.pt/staf/lmbg/).

2.4 Get the potential users involved

As potential users of the NetLab we have the people who use the university labs and the laptop owners (students and teachers).

Different strategies of user involvement must be used for the two groups described. The easiest one is the student group and a more detailed discussion can be seen in [18].

The more difficult group is the teachers group. The challenge is how to develop a "*can-do*" attitude to: 1) teachers start to use ICT in the development of their own learning materials; 2) make advantage of the laptop and network in their own classes; 3) use the network to communicate with students and other teachers; and finally, 4) become publishers and permanent developers of on-line material.

Teachers are right fully cautious about anything that changes the relationship between student and teacher and this is what happens with NetLab; [19] reports that when introducing 3 to 6 computers into a classroom changes social relationships.

On the other side, teachers have a crucial role in the technology adoption and [19] reports a strong correlation between curricular relevance and teacher interest. The same author also states that increase in the number of computers will make a difference on a school wide basis if the first go to teachers who are natural leaders and active in school networks.

A simple strategy to spread the system use is by stimulate a multiplication phenomena to "*pass the practice*" between teachers. An example is an american case where 100000 teachers train at least five other colleagues to use technology as a tool for teaching and learning in a plan called 21st century teachers (http://www.21ct.org).

As a final remark, there is no evidence to suggest that classroom instruction is the optimum delivery method. Distance education is often more individualised and personal than face-to-face instruction [20].

3. TECHNOLOGIES

When dealing with technologies some issues must be well planned especially in an environment with great number of systems owned by multiple kinds of users. This can get even more complex as it can be stated that technology are less stable resources then users and work practice are. In complement, technology is developing astonishing fast and the users (especially teachers) have just become aware of a potential drastic change of the (traditional) work practice [21]. This forces a need for a strong support to keep working hardware, software and network resources (both from users and from university).

Four questions arise when dealing with information technology to harness the NetLab, first proposed by [22] and adapted here:

- *Connections*: how can computers intelligently connect information seekers to sources?

- *Utility*: how can information access be complete (recall), correct (precision), timely, felitious, transparent, authentic, authorised and secure?
- *System evolution*: what architectures can best leverage rapidly changing information environments?
- *Collaboration*: how can groups of people and computers co-operate effectively over distributed networks?

Schools and universities today emphasise working in isolation; however, digitalisation will encourage teamwork [23]. This is reinforced by [24] which states that western business, social and academic culture is ruggedly individualistic; education's focus is on individual performance while employment performance assessment is based almost exclusively on individual performance. Some experiments with group assessment are reported in literature [25]. To confront students with group work, teachers must explicit teach and model teamwork including it in curricula because as [24] states, technically competent students are actually deficient if they cannot apply that competence in a team setting. We can say that co-operative learning is a recent concept as a way of thinking about and conducting the educational process. Although co-operation in learning is not in itself new, the idea of "cooperative learning" as a particular system of learning is [26]. We can found in the literature many references to Computer Supported Cooperative Learning (CSCL '95, the first international conference was held at Indiana University: http://www.cica.indiana.edu/cscl95/). The support from computers can be done by the use of web facilities and on-lines tools as the ones reported at (http://www.iis.sinica.edu.tw/CCL/html/related.html). The functionality of these systems is discussed bellow.

3.1. Cooperative learning for use in CSCL

Co-operation is defined by [27] as "*acting together, in a coordinated way at work, or in social relationships, in the pursuit of shared goals, the enjoyment of the joint activity, or simply furthering the relationship*". [26] refers that co-operation "*is seen as central to our everyday lives*" and "*cooperative learning is process driven*". In the definition of the group, [26] states that a human group is a collection of individuals, who have interdependent relations, and who perceive themselves as a group that is recognised by non members. Finally, group members have interdependent relations with other groups and whose roles in the group are functions of expectations (internal and external). [26] concludes its reasoning saying that people working cooperatively in CSCL environments do work in groups and that these groups work in complex ways. In open learning situations where there are many different simultaneous influences on the group including distributed systems and the use of virtual technologies to augment the group environment it is possible to add some influences from beyond the social structure of the group itself [28].

Co-operative (or collaborative, as it also called) work produces information products like decisions, designs, analysis, minimises information loss, operates a finer level of details [29].

What are the outcomes of cooperative learning? In their work, [30] looked at 323 studies and concluded that cooperative methods lead to higher achievement than competitive or individualistic ones. Other study, [31], states that cooperative learning increases the positive affect of classrooms and students working cooperatively become more cooperative; they learn pro-social behaviours such as how to get with others, how to listen and so on. At last [32] suggests that cooperative learning fosters knowledge about the learning process.

In addition to the individualistic and competitive learning goal structures, the cooperative one can be relevant to education, learning and training, justifying the introduction of ICT that support it.

3.2. The use of CSCW systems

CSCW as a study area, can be considering as a sub-topic within the broader field of Information Systems [33]. With the use of Computer Supported Computer Work systems one can expect to extend the study of learning environments to work environments.

In the keynote address to the Fifth ECSCW conference, at Lancaster, [33] states that a CSCW system implies four items: a group of people; their would-be cooperative activity: an organisational context of some kind and technology supporting the group activity.

A core rationale for CSCW is proposed by [33] and visualised in figure 2 where when information technology IT is in an enabling role its possible to envisage new forms of purposeful action (both individual and group action) which would not otherwise be possible. We must note that information systems process relevant data in order to support or help people undertake purposeful action and IT enables such support to be realised.

The goal of CSCW is to discover ways of using computer

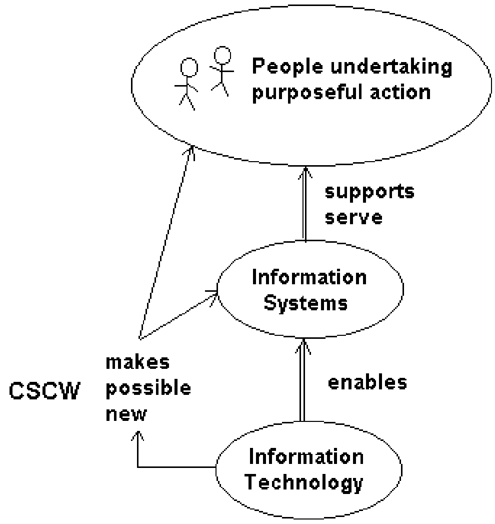

Figure 2 - a rationale for CSCW [33]

technology to further enhance the group work process through support in the time and place dimensions, where the focus of CSCW goal is the social interaction of people, and not the technology itself [34].

4. CONCLUSIONS

Internet and ICT based open and distance learning (ODL) are rapidly gaining popularity and importance as means of providing lifelong learning (LLL) [35]. Use of new technologies like CSCW and VR can enhance collaboration, foster knowledge representation and developed systems that provided vicarious experience.

It also provideds means to augment teaching and learning skills of all the users involved, creating new forms of interaction, dynamic information representation and relations with the learning community in multiple time/space alternatives.

Developing a chain reaction of production and refining learning materials on line is the general NetLab's idea (as a multiplication factor for reaching other teachers).

A main concern in NetLab is drawing an emotional agenda to involve students and teachers. Psycho-pedagogical studies in the educational field have shown that students can better learn by managing, manipulating and organizing the information on their own [36] (we can expected that the same applies to teachers).

This way the author believes that staying tuned to the NetLab concept can grew the potential of a higher education institution, and offer it a path to evolve to a virtual university.

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