

# The NetLab, experience

*Moving the action to electronic learning environments*

**BITE 98**

27th March, 1998

CEREM group

Fernando Pessoa University

**CEREM**

## Introduction the environment

Fernando Pessoa University

- located on Porto (second city in Portugal)
- merging result of two Institutes in the year of 1994
- 4 departments, 20 courses, 3 postgraduate
- 4500 students, 250 lectures, 80 staff



## The students side

Year	Hardware	Software (student license)
1995	Intel 486 dx50MHz, 4 MB RAM, 270 MB HD, LAN pc-card	MS-DOS, Windows for Workgroups, MS Office 4.1
1996	Intel Pentium 100 MHz, 8 MB RAM, 840 MB HD, multimedia, LAN pc-card	Windows 95, MS Office Pro 95
1997	Intel Pentium 133 MHz, 16 MB RAM, 1 GB HD, multimedia, LAN pc-card	Windows 95, MS Office Pro 97

- laptop as a pre-requisite for entry university
  - minimal specs for freshman
- for many, its their first owned machine!

## The university pocket

Year	Number of entry points	Number of servers	Entry points per server
1995	170	1	170
1996	300	5	60
1997	400	10	40

- offer of network entry points
  - classrooms
  - libraries
  - social spaces
- multiple operation environments and a complete set of Intranet/Internet network facilities

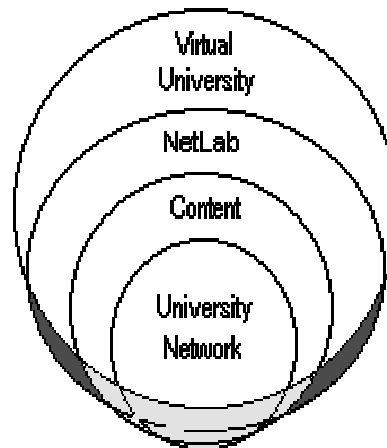
## Laptop numbers

Year	Students	% covered	Professors	% covered
1995	1100	25,6%	50	21,7%
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<i>total</i>	<i>2300</i>	<i>4500</i>	<i>100</i>	<i>250</i>

- there's a 1 to 6 ratio of entry points to laptop owners
- early adopters start to substitute their machines
- most of the software used is freeware or shareware

## The NetLab concept

- network infrastructure, content oriented
- links computer resources
- experimental education lab
- entry points to virtual campus
- prototype for local information society
- emphasis interpersonal communication among students



## The NetLab potential

- offer a local interaction engine;
- people-centered and not technology oriented;
- strong reinforcement of mobility;
- provides a greater involvement between students and university by sharing of technology investments
- permit relocate the use of tools for information manipulation from classrooms to all spaces of the university

## The questions

- Internet bring a reality resource
  - explore network, intranet and laptops presence
  - keep all minds clear for access, select, evaluate and discover information from all over the world
- how can the NetLab be used in education activities
  - what are the possible modifications in each individual student?
  - what are the effects on the students assessment results?
  - what are the effects on the students motivation?

## The experiment

### – local intranet use of a Web homepage

- test the potential of the intranet facilities to soften the theoretical and descriptive bias of the content subject
- the courses selected belong to non technical related student type, with little knowledge in the use of networks

### – experiment goals

- training students to be more active and test their individual capacity to collect information
- force students to manage their project submissions and interact among them
- give a choice of place/time to interact with the professor and class materials

## The experience setup

- design a clear and small group of rules
  - they must be simple enough not to frighten students and provide a clear path of how to react to the class
  - six rules are enough!
- introduce computer tools that provide a clear set of functionality
  - something students understand and feel good using
  - 20 hours to introduce the basics: prepare the laptop to use network services, use a browser, a mail reader, understand hypertext, how to built Web pages to publish, a Windows chat and an IRC program

## Evaluation method

- study groups
  - two classes: same content, same course, students were distributed to each class in random, from groups of equivalent marks
  - one group use computers and the other do not use neither computers nor the network facilities
- data gathering
  - a final set of questions about the class and students motivation to attend lectures
  - the marks obtained in two different assignments and the final class result
  - server statistics

## The results

Services	Experimental group	Control group
WWW	100%	28,5%
Email	57%	28,5%
IRC	100%	71,4%
FTP	28,5%	14,2%%
Chat	85,7%	28,5%

Services	Experimental group	Control group
Gather information	64,3%	21,4%
Asynchronous com. Fac.	57%	28,5%
Synchronous com. Fac.	92,9%	50%

Www + ftp  
email  
irc + chat

## The results

Question	Experimental group	Control group
understood the concept of an Information System	4.0 in 5 for yes	4.0
learned something new in Information Systems class	4.57 in 5 for yes	3,71
define the subject as a practical one or theoretical	2,1 in 5 for theoretical	3,71
4 hour/week for the class is adequate	4,2 in 5 for yes	2,1
importance of the class to their future professional life	4,6 in 5 for yes	3,2
relevance of the Information Systems homepage	4,0 in 5 for yes	4,57
approvals	75%	65,5%.
marks	14,6 in 20	13,2 in 20

## The results

- students involvement has been higher in the experimental group
  - it created expectations for the use of their notebooks in other University context
  - tend to classify their work in the class as a practical one and to discuss concepts in a deeper way
  - they found and use new forms to interact between them and with the staff
  - the experiment has also some effect in the way students see their laptops, since they invest in upgrades (two times more cases in the experimental group: 42% against 19,8%).

## Conclusions

- the experiment reveals a Internet potential to class support
  - a path to get students involvement is to make them build their own representation of concepts and class content
    - can it be used in other classes?
- based on laptop use, it can be devised new forms of outside classroom work:
  - we can explore the idea of a '*never ending class*' with an impact that deserves further study
    - is it good?
    - can students cope with more simultaneous classes using the same concept?
    - can this really introduce better content understanding?

## The opportunities

**Redefining University as a *education lab* without physical boundaries like the classrooms walls**

**Harness the use of a virtual space to information interchange between net users that offer a *living organism* of ideas and regular meeting**

*The killer application of the 90s is people*

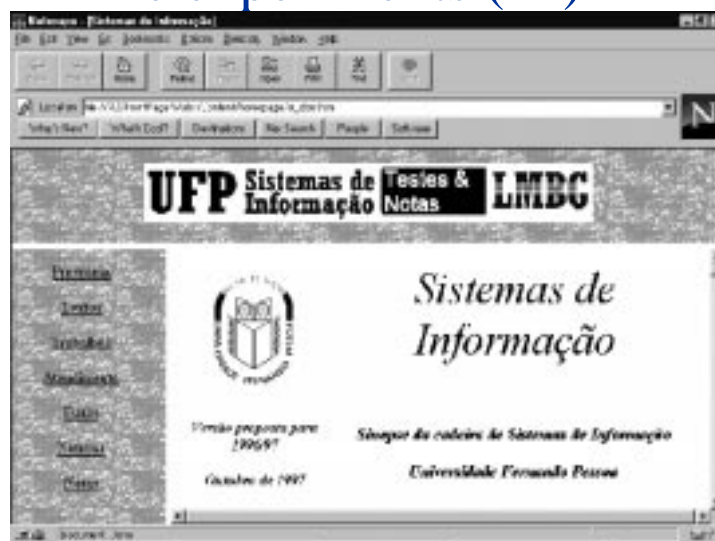
Pavel Curtis



## The vision



## The experiments (III)





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

## What is this about?

- discussion of the supporting role of ICT - *Information & Communication Technology* - in education activities
  - puts in context the impact that **CSCW**, *Computer Supported Cooperative Work*, can have both in **ODL**, *Open and Distance Learning*, and in general education, learning and training
- the **NetLab** concept is presented and serves as the base to propose a **roadmap to a virtual university** setting

## The context

- on-line applications in classroom are a widespread trend in industrialised societies
  - dual-mode education is gaining acceptance (on-campus and distance education)
  - the ratio between print, electronic media and face-to-face sessions will change from 85:0:15 to 69:25:15 (fall 2000 figures)
    - print will not disappear and stays as the most used media
    - electronic media gains importance as a current media
    - face-to-face sessions remain with the same overall weight

## A roadmap to a virtual university

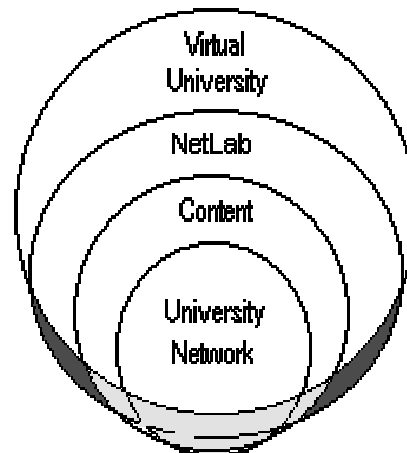
- shift from traditional face-to-face sessions to a broader offer of learning facilities integrating both on-campus and off-campus activities
  - based on the university resources (human, location, facilities and knowledge database)
  - new offerings act also as innovations that introduce shorter and more learner-oriented education settings
  - rethink the time spend in consecutive periods in education programs; time is playing an important role as more and more lifelong education is a requirement

## The environment

- private higher education institution
  - 4900 students, 380 teachers and an administrative staff of about 80 people (last academic year figures)
  - 10 years of history, starting as university in 94 as the merging result of two Institutes
- characterised by simultaneous presence of:
  - a network with 400 DHCP entry points, in labs, classrooms and social locations (1 access for each 6 users)
  - access to the most usual Internet services
  - every student has his own laptop computer (since 95)

## The NetLab concept

- prototype for local information society
- entry points to virtual campus
- experimental education lab
- promotes the content creation by teachers and students
- network infrastructure, content oriented
- emphasis interpersonal communication among students
- links computer resources



## NetLab contributions

- is people-centered and not technology oriented;
- has a strong reinforcement in mobility;
- provides greater involvement between students and university by sharing of technology investments;
- provides a space for multidisciplinary projects;
- first step to prepare and prototyping on-line material and off-campus on-line courses and train teachers to integrate ICT technologies in their activity
- take advantage that higher education institutions constitute one of the major content producers and have a proper workforce to maintain these materials update and usable

## Get the potential users involved

- teachers have a crucial role in the technology adoption with research results reporting a strong correlation between *curricular relevance* and *teacher interest*
- a proposal for teachers involvement
  - start using ICT in the development of their own learning materials;
  - take advantage of the laptop and network in their own classes;
  - use the network to communicate with students and other teachers;
  - become publishers and permanent developers of on-line material.

## Technologies

- need for a strong support to be effective
- area of fast change and great setup costs
- four questions arise when dealing with IT to harness the NetLab:
  - connections: how can computers intelligently connect information seekers to sources?
  - utility: how can information access be complete, correct (precision), timely, transparent, 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?

## Why CSCL and CSCW

- three issues about cooperation
  - defined as "*acting together, in a coordinated way at work, or in social relationships, in the pursuit of shared goals...*"
  - is seen as central to our everyday lives
  - cooperative learning is process driven
- 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
- people working cooperatively in CSCL environments do work in groups in complex ways

## Why CSCL and CSCW

- What are the outcomes of cooperative learning?
  - cooperative methods lead to higher achievement than competitive or individualistic ones.
  - 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.
  - cooperative learning fosters knowledge about the learning process

## Why CSCL and CSCW

- CSCW as a study area, can be considering as a sub-topic within the broader field of Information Systems
- with the use of CSCW systems we can extend the study of learning environments to work environments
- a CSCW system implies four items:
  - a group of people;
  - their would-be cooperative activity;
  - an organisational context of some kind;
  - technology supporting the group activity.

## Why CSCL and CSCW

- the goal of CSCW is to discover ways of using computer technology to further enhance the group work process through support in the time and place dimensions
- the focus of CSCW is the social interaction of people, not the technology

## Conclusions

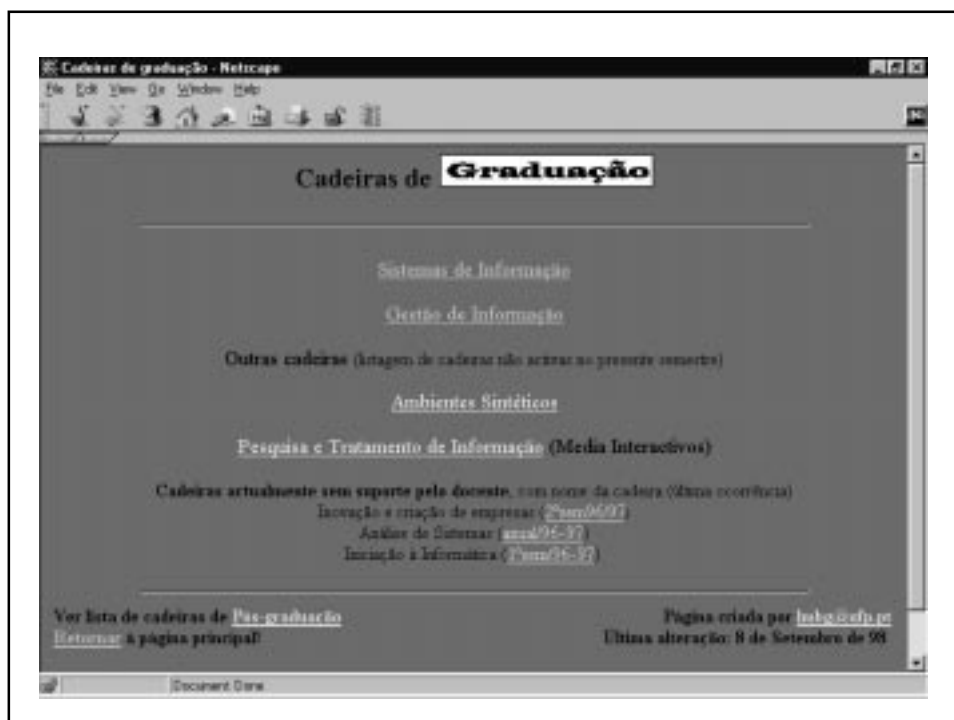
- the technologies...
  - Internet and ICT based ODL are rapidly gaining popularity and importance as means of providing lifelong learning - LLL
  - use of technologies like CSCW and VR can enhance collaboration, knowledge representation and developed systems that provided vicarious experience

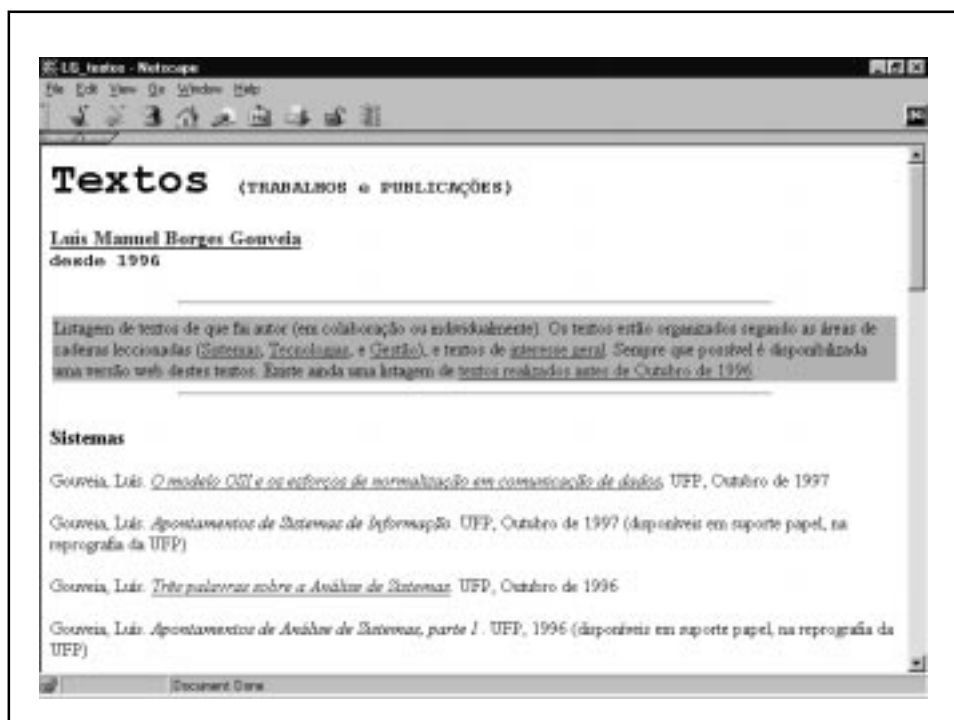
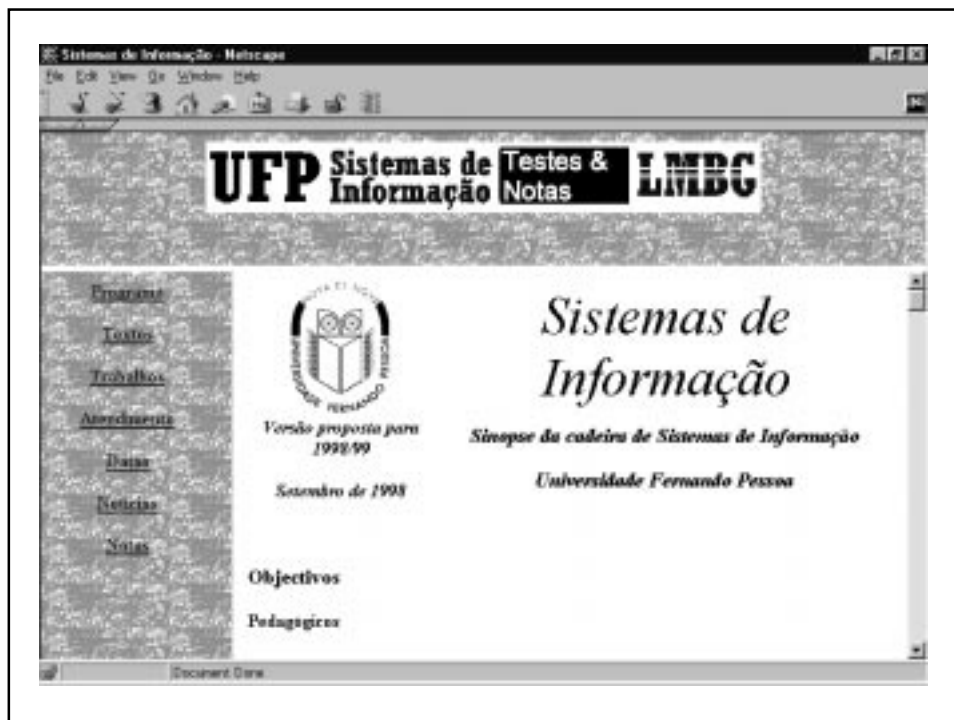


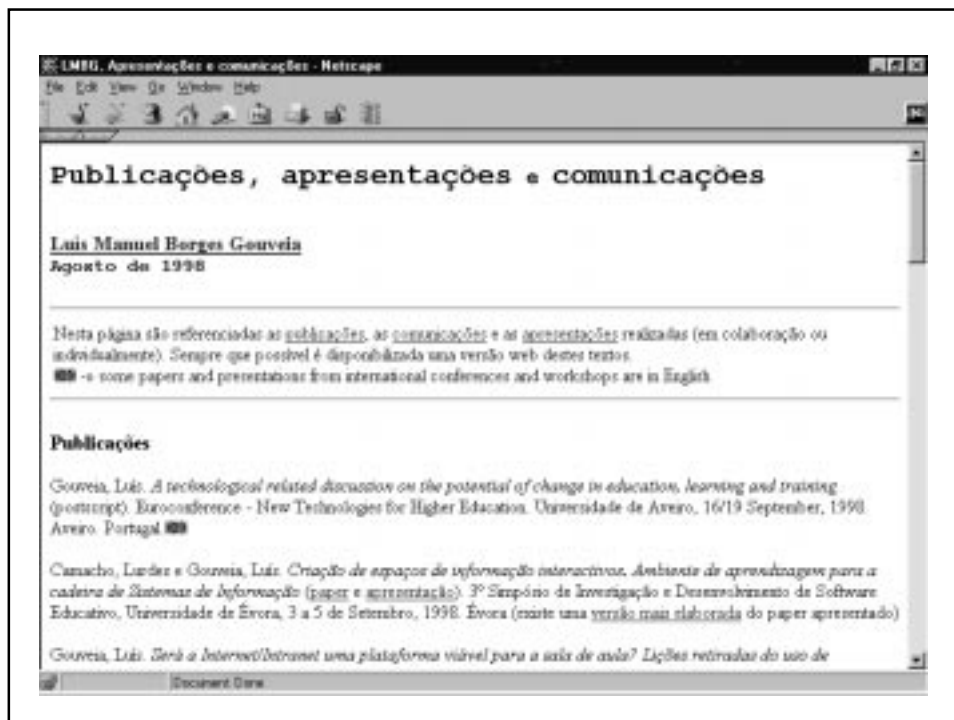
## Conclusions

- the system...
  - developing a chain reaction of production/refining learning materials on line is the main NetLab's idea
  - a major NetLab concern is to propose an emotional agenda to involve its users
  - psycho-pedagogical studies in the educational field shown that students can better learn by managing, manipulating and organizing the information **on their own**









## The role of teachers in rich technological environments

**Discussion about intensive use of laptop computers by non technological students: trials and effects**

Luís Manuel Borges Gouveia  
Universidade Fernando Pessoa

## Experiment setup

- class selected: Information Systems
  - chosen to test the potential of the Intranet facilities (most of them accessed from a web browser),
  - to soften the theoretical and descriptive bias of this content subject.
- the courses selected belong to non-technical related student type, with little knowledge in the use of networks or Internet services.

## This experiment has several goals in mind

- promote the use of the intranet services and internet potential among students;
- training students to be more active and test their individual capacity to collect, browse, and, search, and understand information;
- force students to manage their project submissions and impose time restrictions;
- evaluate the amount of teachers work to support and maintain a homepage;
- evaluate alternate place/time to interact with the professor (in a classroom context).

## Main question

The discussion will be conducted based on the following question:

*Can the presence teaching transforming itself, when using web based facilities, to meet some ODL requirements?*

## Results - the student side

- the impact of this particular use of Intranet facilities was significant
  - students involvement as been higher than the one from other equivalent classes
  - creates expectations for the use of their laptops in other University context
  - students tend to classify their work in information systems as a practical one and to discuss concepts in a deeper way
- also some effects in the way students see their laptop computers

## Results - teacher side

- Some changes can be expected in classroom teacher's role
  - more informed students, with more information available and with difficulties to structure it
  - this can be seen as a great opportunity to teachers help students, organising the students own results and (as an important factor) by their own demand

## Results - teacher side

- our class experience states that the more oriented approaches (case studies, oriented tasks) seem to have less impact than open proposals to gather information and report results
  - this leads to the following question that requires further study:

*can the laptop use in classroom turn possible the increasing success in the making of active learning projects?*

## Results - teacher side

- each student has now his own available path to organise and operate his learning activity and use laptop in class on his own way, several problems may arise.
- new forms of amusement, classroom confusion, and dispersion.
- because of chat and network communication facilities is extremely difficult to the teacher monitor without appropriate network tools

## Some questions to work on

- one can expect to involve students using some group techniques, collaboration and competitive tasks to coordinate activity in classrooms

*What are the most useful computer tools to support that?*

*Do we need to specify new computer tools to classroom use?*

*Is the computer use possible in a natural way in face to face collaborative situations?*

*Are the specifications for presence support learning electronic tools really different from the found in the ODL environments (where, how and why)?*



## Results - teachers side

- most of the teachers who use web facilities tend to post information as a complement to the more traditional media, because
  - this means to learn other competences and,
  - this represents an enormous time investment, not normally considered as a pay work to the institution.
- we consider the laptops use in classroom as a gradual evolution force to the teaching activities, but just in the long run

## Conclusion

- the need for better tools to support information and teaching materials as some form of technological scripts similar to the ones encountered in textbooks
- before the use of "*compubooks*" or "*digitalToolBooks*" (or Interbook, from Carnegie Mellon University) be seen as a potential resource to the teachers activities, some specialized work force (like publishers do in books) need to produce specific materials.
- its seems that still a point stays the same: **the teachers are largely facilitators and performers, not creators**

*Será a  
Internet/Intranet  
uma plataforma  
viável em sala de  
aula?*

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## Questões

- *Será a Internet/Intranet uma plataforma viável em sala de aula?*
- Lições retiradas do uso de computadores portáteis e da web em sala de aula
  - qual o ambiente utilizado e desenvolvido
  - qual o impacto nos alunos
  - qual o impacto no professor
  - o que se ganha e o que se perde

## Internet

- “rede das redes”, interliga computadores à escala global
- enorme acervo de informação e de recursos de múltipla origem e variada qualidade
- permite acesso e comunicação de diversas formas, com funcionalidades bem definidas
  - **Web** (World Wide Web), **e-mail** (correio electrónico), **IRC** (Internet Relay Chat), **news** (listas de discussão), **telnet** (acesso remoto) e **ftp** (transferência de ficheiros)

## O ambiente em estudo

- ensino superior, com uma potencial comunidade de 4500 utilizadores
- caracterizado pela existência simultânea de:
  - uma rede de dados com cerca de 400 pontos de entrada distribuídos por laboratórios, salas de aula e zonas sociais
  - disponibilidade de utilizar os serviços Internet mais comuns (atrás referidos)
  - existência de um computador portátil por aluno

## A cadeira e o professor

- *Sistemas de Informação*,
  - 2º ano de diversos cursos (introduz conceitos gerais relacionados com as T.I.'s, para não especialistas)
  - adequada à exploração do *ambiente* rede, serviços e computadores portáteis
  - existência de uma *memória digital da cadeira*, integrada numa presença digital web (*site*), do professor com componentes de conteúdo, administrativa e de animação em sala de aula

## Impacto da Web

- acesso facilitado à informação
- quantidade elevada de informação disponível
- qualidade e valor da informação requer avaliação
- origem global da informação
- acesso a contextos ed. semelhantes e concorrentes
- permite demonstração de conceitos e recursos
- facilita acesso a textos e apresentações
- acesso a informação diária
- acesso a listas de discussão temáticas

## Resultados

- a presença de computadores em sala de aula, muda as relações de poder professor-alunos
  - o professor lança as propostas de trabalho, mas não controla a sequência de acontecimentos que lhe seguem;
  - a relação de um para muitos, estabelecida entre professor e alunos muda para uma relação de muitos para muitos, com os alunos a interagirem, regulados pelo professor;

## Resultados

- a presença de computadores, exige do professor grande disponibilidade para prestar suporte tecnológico;
- aumento da dificuldade de controlo de disciplina em sala de aula, embora continue a depender da motivação dos alunos;
- a parceria entre professor e alunos aumenta;
- a motivação dos alunos passa pelo pedido de resultados, com o seu desempenho medido (e conseguido) em função dos resultados.

## Avaliação em grupo de trabalho

- grupos de 3 alunos: o primeiro fica na sala de aula onde se realiza o exame. O segundo fica na biblioteca onde tem acesso aos livros e revistas aí existentes. O terceiro aluno fica numa sala de aula ou local de acesso à rede onde reunir outros elementos, que o possam auxiliar.
- os três elementos estão isolados entre si e a única forma de comunicarem é via rede.
- o exame consiste na resposta a um pequeno conjunto de questões de relacionamento que exige a recolha, discussão e comparação de informação

## Avaliação individual

- cada aluno está em sala de exame com o seu portátil. Não é permitida a utilização de rede e o aluno é informado com um mês de antecedência do tema do exame, podendo preparar esse tema;
- a primeira parte do exame é constituída por um conjunto tradicional de questões. O segundo grupo (60% do exame) é composto por seis desafios em que o aluno responde, criando aplicações em computador.
- o desafio consiste na utilização de hipertexto, de multimédia e hipermédia como formas alternativas à escrita para responder às questões do exame.

## Conclusões

- a utilização da Internet em sala de aula, combinada com um rácio de um para um de alunos e computadores:
  - exige novas formas de relacionamento entre professor e aluno;
  - implica alterações no processo de ensino aprendizagem;
  - constitui um desafio para o professor, mais em atitudes do que em novas competências do domínio tecnológico.

## Conclusões

- faltam aplicações, metodologias e programas adequados para tirar partido destes novos contextos educativos que se adivinham ricos e são bem aceites pelos alunos
- os sistemas de avaliação descritos foram considerados:
  - mais justos, de maior desafio e de maior utilidade pelos alunos (que gostariam de ver repetidos, pois aprenderam com eles). No entanto, as notas foram, em média, 20% inferiores

## Questões a colocar

- Quais as metodologias adequadas para um contexto como o descrito? Qual o papel do professor?
- Qual o trabalho que deve ser desenvolvido em sala de aula e qual pode ser feito à distância?
- Como compatibilizar os actuais programas com estes novos contextos? Vale a pena fazê-lo? Quais são os benefícios obtidos? Os alunos aprendem mais?
- É possível pensar na criação de contextos (rede, serviços e portáteis) suportados por aplicações da mesma forma que os livros suportam o modelo actual?

## Feasibility discussion of a Collaborative Virtual Environment

*finding alternative ways for university members interaction*

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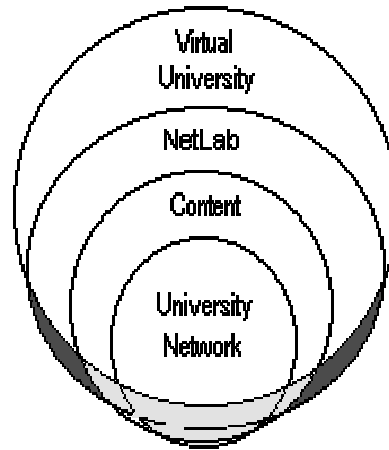
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## cyberspace

*Cyberspace is a globally networked, computer-sustained, computer accessed and computer-generated, multidimensional artificial, or "virtual" reality*

*"...this reality, to which every computer is a window, seen or heard objects are neither physical nor, necessarily, representations of physical objects but are rather, in form, character and action, made up of data, of pure information"*

Benedikt, 1991

## Collaborative Virtual Environment

- **defined as a "cyberspace meeting point" which allow several people to interact through their computers in order to obtain a common goal**

(Benford, 1993)

- **involve the use of distributed virtual reality technology to support group work**
- **two conditions to a system to be considered a CVE:**
  - the provision of simultaneous multi-user access to a virtual reality system,
  - explicit consider and support the needs of users who wish to work together.

(Benford, 1997)

## Virtual environments in higher education

- design a clear framework to be used by all potential users
- provide technological support
- produce content and reuse, reuse, reuse!
- keep it simple and add functionality just by demand
- more people, different people, the better!
- publishers and creators must have some sort of benefit

## *any phenomena*

the amount of information available about *anything*, *anywhere* and *anytime*, accessed from *everywhere* in huge amounts makes impossible to *anyone* to maintain a global knowledge, even in a restricted area, on an individual basis

information society means a society where the interaction is predominantly digital based?

## *anyspaces*

- each student organises his own activity in *anyspaces* that can be private or shared among others
  - using a CVE system we can make some individual or group actions, co-operate and compete for information and credits, and use this potential as a real work tool, not as a substitute but as an enhancement one
- information has become a dead resource
  - information is fast becoming a *hygiene factor*, something we only notice the value of in its absence (Barnatt, 1997)

## The proposed project

- information is not the issue
- proposes a global information system environment where several thousand people work and produces potential answers for someone's specific problem.
- three types of users, with different roles: students, teachers and associates
- associates are professionals from outside university environment like enterprises and government

## The proposed project (cont.)

- products, services or activities that classify for potential use are the ones that match
  - creativity, knowledge, expertise and imagination
- the system is web based
  - organised into projects that can evolve to virtual spaces with credit offering in classes
- students can exchange competences, skills and several kinds of work among them
  - providing that they be effective members of the related virtual space
- each virtual space (anyspace) can be created by students, teachers or mixed groups
  - that can contain any number of individuals from one to many

## The proposed project (cont.)

- the credit system is based on
- hours to teachers,
- credits for students
  - this way we can redefine the time in which a particular student can take his degree
- traditional membership cost to the associates
  - associates contribution can also be valued by giving them credits for professional certification (a need in a life long learning society)

*The killer application of the 90s is people*

(Pavel Curtis)

## Criação de espaços de informação interactivos

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CEREM / UFP

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## O ambiente da UFP

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  - uma rede de dados com cerca de 400 pontos de entrada distribuidos por laboratórios, salas de aula e zonas sociais
  - disponibilidade de utilizar os serviços Internet mais comuns (web, e-mail, news, UNIX, ftp, IRC, bdados e windows)
  - existência de um computador portátil por aluno (2300)

## Espaço de informação

- estrutura, para a qual um computador constitui uma janela, em que os objectos visualizados ou percebidos não são apenas representações de objectos físicos, mas também constituídos por dados e informação
  - quando esse espaço de informação é comum a um conjunto de indivíduos, designa-se por um espaço partilhado ou espaço de trabalho
  - os elementos de um espaço de informação variam em natureza e funcionalidade

## Ambientes virtuais colaborativos

- utilização combinada de espaços de informação para suporte de trabalho em equipa
- ponto de encontro no *cyberespaço* que permite a interacção de diferentes pessoas através dos seus computadores, para alcançarem um objectivo comum
- existem duas condições para um sistema ser entendido como um CVE (*collaborative virtual environment*)
  - acesso simultâneo de vários utilizadores a um sistema de realidade virtual
  - prover e suportar de forma explicita as necessidades dos utilizadores que queiram trabalhar em conjunto

## Porquê utilizar uma metáfora

- facilitar uma imagem geral do modelo, estrutura e regras que seja fácil de utilizar
- criar um ambiente o mais natural e intuitivo possível para o aluno
- suportar o conceito de tempo e de espaço para estruturar os dados, a informação e o conhecimento que o aluno vai organizando
- suportar a interactividade e relação entre professor e aluno e entre alunos



## Protótipo

- Objectivo
  - possibilitar ao aluno a organização da própria informação e construção da *sebenta* pessoal, em **constelação** animada e recorrendo a elementos 3D, a partir de um conjunto de informação base, (uma **estrela**), fornecida pelo professor
- uma **estrela** é um conjunto de informação autónomo a que pode ser adicionada nova informação
  - bibliografia, segmentos multimédia, comentários, endereços Internet, sons, imagens, gráficos, apontadores para recursos multimédia, representações 3D - **planetas**
  - as estrelas são organizadas em constelação para melhor visualização e relacionamento no espaço

## Protótipo

- o professor tem acesso ao espaço de informação que constitui a constelação/*sebenta* de cada aluno, em construção
  - quando os dados não estiverem correctos pode **bombardear** as parcelas erradas - actividade de pontuação que torna visível as ligações da constelação (ou dos seus elementos que constituem cada **estrela - planetas**) que passam, assim, a estar apenas disponíveis para o próprio aluno
  - quando cada elemento for sendo acabado (**estrela e planeta**) a sua visibilidade irá aumentando sucessivamente: turma, pelo curso, pela universidade e, mesmo, pela Internet (exterior)

## Protótipo

- o **universo** (área de saber em estudo) é construído e enriquecido com diferentes análises dos assuntos, bibliografia, trabalhos de outros alunos, considerados importantes, constantes de cada constelação organizada no decurso de cada período lectivo
  - é possível consultar os trabalhos desenvolvidos, recolher informação junto de outros trabalhos (que fazem parte desse universo), desde que utilizada em novas construções
  - fomenta o trabalho de grupo, a soma das aprendizagens e o desafio da superação constante mesmo entre trabalhos da mesma área

## Protótipo

- a organização e exploração do **universo** permite:
  - a criação de percursos orientados que potenciem uma visão e fio condutor do espaço de informação - **nave** - garantindo a linearidade necessária para o estudo introdutório de uma área de conhecimento
- após cada semestre ou ano lectivo, é realizada a análise do universo
  - reunião do trabalho de todos os grupos, elaborando uma memória própria do universo criado com eleição dos pontos fortes do trabalho realizado e com a redacção de um balanço que premeie as melhores realizações

## A mais-valia da tridimensionalidade

- a apresentação e representação de dados de difícil percepção e relacionamento é facilitada
- maior interacção entre o mundo virtual e o utilizador
- manipulação dos dados mais intuitiva
- alguns exemplos de utilização:
  - mercados financeiros
  - gestão de programas informáticos
  - visualização científica
  - medicina
  - simulação molecular

## Ambientes virtuais para aprendizagem

- apresentação de informação complexa sob uma forma simples
- desafio lúdico que gera motivação
- interactividade em tempo real
- controlo do ambiente
- experiência pessoal e auto-aprendizagem
- aprendizagem pela descoberta do conhecimento
- construção pessoal do saber

## Ambientes virtuais para aprendizagem

- desenvolvimento de capacidades
  - desafios colocados pelo professor - motivação para novas aprendizagens
- superação de dificuldades
  - adaptação ao tipo e ritmo de aprendizagem
  - visualização de informação complexa de forma simples
  - do raciocínio reflexivo ao raciocínio experimental

## Ambientes virtuais e colaborativos para aprendizagem

- um espaço de trabalho partilhado pelo grupo
- entre-ajuda e solidariedade *versus* individualismo
- um universo de conhecimento feito de constelações
- um universo em expansão:
  - para toda a universidade
  - para outras áreas do conhecimento - projecto multidisciplinar
  - para outras universidades
  - para novas metáforas e novos mundos