Information Technologies Supporting Learning

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Thanks for the invitation to the CSEDU Organizers!

Information Technologies Supporting Learning supersedes Computer Supported Education

(Institute for Systems and Technologies of Information, Control and Communication)

European Union > TEL > Technology Enhanced Learning
Thanks for the invitation to the CSEDU Organizers!

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- E-Learning Evolution
- Blended Learning
- SOA
- Services in Learning
- Reuse of Services
- Reuse of Learning Objects
- Conclusions
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Introduction

- A new Higher Education
  - Declaration of Bologna (1999)
  - Implementation by 2010
  - New Technologies ↔ New Methodologies

- The New European Area
  - A model closer to North America and Japan
  - Greater importance to the practice load
Introduction

- A new orientation → more experimental tasks
- A clear direction → professional world

- EHEA boosts mobility
  - In &
  - Outside of Members Countries

- Members Countries could move to any others
  - Continue studies in anywhere

- No-Members attract to study in this new education plan
Introduction

- Mobility of people ➔ Immediate translation
  - Increase economy
  - Generate jobs
- Of course…

Negative Aspects
Introduction

- Negative Aspects
  - Depend on each country

- Could it bring more benefits?

- Disadvantages in common:
  - Economics &
  - Academic aspects

- New vocational studies
- What happens to the ancient engineering?
A case of study

- Also, there are some obstacles own of each country

- How far is each educational system to the new European model?
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A case of study

- In Spain,
- Current model, 2 types of degrees:
  - “Diplomaturas”/Technical engineering (3-year)
  - “Licenciaturas”/Engineering degree (5 or 6-year)

- What would they be???
  - Degree of 3-year → BS/BSc
  - Degree of 5-year → MA/MSc

- Problem: These degrees are not exact equivalent
A case of study, Spain

- Problem
  - 3-year degrees → vocational and experimentation tasks
  - 5-year degrees → theoretical knowledge

- But in the own country
  - Similarity between universities in the curriculum of a particular degree are scarce
  - Different importance for the same subjects
  - Subjects exist only in a few universities
To adopt the new model

- To get the New European model
  - A common consensus in the country itself

- However,
  - The process goes on
  - All the universities and countries try to adopt it by the deadline
Bologna Process

- Sets the framework of IT-based approaches
  - must operate
  - must support

- 2 major interrelated sets of changes
  - Set 1 – US-like unified cycles & ECTS
  - Set 2 – At shifting the focus on “active learning”
Bologna Process – Set 1

- An unified cycle structure involving
  - Graduate
  - Master
  - Doctoral cycles

- A single unit of measurement, the ECTS
  - 25-30 hours of total effort
  - Before, it was hours of face-to-face

- Consequences:
  - Re-design
  - Re-accreditation of all the degrees
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Bologna Process – Set 1

- This massive simultaneous redesign presents
  - Daunting challenges
  - Unprecedented opportunities

- Synergies among the redesign can be exploited

- The re-utilization oriented approaches
  - LCMS
  - Dublin Core
  - QTI
  - IMS
  - SCORM, etc.
ECTS facilitates the seamless combination of

- Face-to-face
- Distance
- Blended learning

integrating evaluation in the process
At shifting the focus
- From instructor-centered “teaching”
- To student-centered “active learning”

Methodological changes such as:
- Continuous evaluation
- No more emphasizing theoretical lectures
- Focus more on assignments and projects
- Higher practical focus
- Higher flexibility for students
With this methodological shift

The introduction of effective IT based approaches

- Alleviate the burden on the instructor’s resources
- These should facilitate the trend towards “mass-customization”
- Allow individually tailored learning
- Level of resources similar to the standardized education
Bologna Process

- Opportunity to introduce far-reaching modifications in the educational systems

- In Spain, so far
  - All the official degree were listed in a catalogue by the Education Ministry
  - On the catalogue, name & curriculum degree of each degree
  - The new system breaks away from that closed catalogue
Bologna Process

- Now in Spain,
  - There are generic guidelines to which new degrees should conform
  - Universities are free to propose new degrees and their curriculum
  - Always the proposal must be cleared from a quality criteria point of view
    - Faculty CVs
    - Cohesiveness
    - Appropriateness of IT infrastructure
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Bologna Process

- A last bad aspect is
  - That emphasis on promoting mobility and
  - The international dimension in education

- To get this objective,
  - The adoption of standards-based
  - Location independent IT-based educational solutions
Bologna Process

- These should support both
  - Distributed need of learning services
  - Their consumption by distributed students groups

- In conclusion, it will provide
  - Interaction between students & instructors
  - Interaction among participants in distributed teams
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- **E-Learning Evolution**
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- SOA
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E-Learning Evolution

- A clear desire for a common area of Higher Education

- Seeking solutions and models

- Technology gives a noticeable change in the methodology
  - On the side of teachers
  - On the side of students
E-Learning Evolution

- Nowadays Education offers
  - Synchronously communicate, teacher-students
  - Collaborative tools
  - Documentation
  - Opinion board, etc.
  - To be renewed every day

- E-learning has changed continuously during the last 15 years
E-Learning Evolution

- At first, only digital content
  - Text files
  - Hypermedia documents

- Nowadays, e-learning concept involves a wider range of technologies
### Information Technologies Supporting Learning

#### Different Technologies in Nowadays

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E-Learning Evolution

- The backbone of this evolution

The Technological Revolution

- The fact: There is not a new pedagogical methodology

- The real change is based on
  - New services
  - New possibilities
E-Learning Evolution

- E-learning was used to define on-line environments
- The offer of distance learning course has increased

- E-learning,
  - To distance learning
  - To flexible learning
  - But also, in conjunction with face-to-face teaching

  **Blended learning**
E-Learning Evolution

- The tendency is to create a VLE
  - Sometimes with MIS to create a Managed Learning Environment

- All the aspects of a course are handled through a consistent user interface standard

- E-Learning lessons are designed
  - To guide students through information
  - To help students perform in specific tasks
E-Learning Evolution

- Common standard format for e-learning content
  - SCORM

- The way to implement the new technological resources
  - Depend on programmer or
  - Teacher of the course

- The level of involvement between student and teacher &
- The level of content of the course

Change depending on the preferences given
E-Learning Evolution

- Examples:

- A course of international politics will need
  - Tools that give synchronous communication
  - Appear natural and fluid

- A course of self-study will need
  - Asynchronous communication
  - Documentation
  - Assessments
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Communication & Technology associated

- **Communication:**
  - Asynchronous
  - Synchronous

- **Asynchronous:**
  - Blogs, wikis & discussion boards
  - Email
  - No real-time interaction with other users

- **Synchronous**
  - Chat sessions
  - Virtual classes
E-learning 2.0

- Web 2.0

- Impetus to
  - All collaborative tools
  - A social aspect

- Virtual communities
  - Able to get documentation
  - Live communication with others
  - Example: Second Life
E-learning 2.0

Diagram showing the transition from Web 1.0 to Web 2.0, highlighting the role of internet contributors and internet users organized into social networks.
E-learning 2.0

- In this second generation, e-learning in itself has not changed
- Take the influence of current interest
- Use all the technology possible
- Apply all to education learning

- **Problem**, the way to raise learning takes another way
E-learning 1.0 & 2.0

- **E-learning 1.0**
  - Students took the contents of a course
  - With some practical exercises
  - Those practices were evaluated by teachers

- **E-learning 2.0 emphasizes**
  - Communication
  - Exchange ideas
  - Synchronous or Asynchronous
E-learning 1.0 & 2.0

- E-learning 1.0 focused on
  - Using Internet to replicate the instructor-led experience
  - Content was designed to lead a learner
  - Providing a set of interactions, experiences, assessments and simulations

- E-learning 2.0 ➔ Collaboration
  - The knowledge is socially constructed
  - Claim the best way to learn something is to teach it to others

Web 2.0
# E-learning benefits

- Virtual environment ➔ Reduction of paper usage
- Reduce costs of Higher education
- Time to update content & correction is very low
- Perception is a livelier interaction with huge contents
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Web evolution

- It started from the idea of sharing knowledge
- Developing nets where
  - Share ideas
  - Situations
  - Images
  - Any educational resources &
  - Knowledge on an open way

- UNESCO, some definitions
  - Open knowledge
  - Knowledge-based society

Web 2.0
Web evolution

- UNESCO adopted in 2002 the concept OER
  - Open Educational Resources
  - Materials and other learning subjects offered openly through the use of IT
  - For consulting, use and adjustment to a user’s community
  - No commercial purposes
The Open Course Ware (OCW) project

- It started at MIT in 2001
- The aim of offering pedagogical materials in an open and free of charge basis to society
- At present, MIT provides about 1800 courses
  - Freely and
  - Universally accessible on the net
- Main objective
  - Teaching resource
  - Other educators’ students
  - graduates
  - Anyone who wants to improve their knowledge
  - sharing
    - Free & Consistent
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The Open Course Ware (OCW) project

- This philosophy spread to the world

- Main universities have created the OCW Consortium
  - More than 200 universities & institutions

- Conditions to be included into the project:
  - Technical demands a globally
  - Approachable site via Internet with the right quality
  - (No requirement) most of participants use the technology of content management based on eduCommons
The Open Course Ware (OCW) project

- eduCommons
  - Open Source project built on Pone
  - Developed by “The Center for Open and Sustainable Learning”
  - By Utah State University
Web evolution

- Web 2.0 to 3.0
Web evolution

- Web 2.0
  - PENDING ISSUE >>> everyday interactive Video

- Web 3.0
  - Semantic web
  - Content based
  - Knowledge
  - NAVIGATING
  - FINDING

![Image of web evolution chart](image.png)
Web evolution

- Web 4.0 ???????
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By b-learning, a new way of convergence between
- Distance
- On-line
- Traditional education

Through a mixed model of education with different percentage of each methodology
- Depending on students or learner approach

The new approach is learner-centered
Blended Learning

- Learners depending on their availability
  - Will adopt a mix-approach
  - Including elements of
    - On-line
    - On-class
    - Collaborative tools through classic distance education
B-learning is the answer for Distance Education (and for traditional ones now) => Implement EHEA

B-learning is the process of incorporation many different learning styles
Blended Learning

- Traditional Learning
  - Local Knowledge
  - Static content
- Passive Learning
- Collaborative Learning
- Asynchronous communication
- Dynamic content
- Distributed Knowledge
- Individual Learning
- Mobile Learning
- Virtual Learning

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Blended Learning

- Typical example – combination of
  - Technology-based materials
  - Face-to-face sessions
  - An instructor starts a course with an introductory lesson in the class
  - Follow-up materials online
  - Also, it can be integrated in LMS

- At first, b-learning is
  - The combination of e-learning & m-learning with other resources
  - The key is human intervention
Blended Learning advantages & disadvantages

- **Advantages:**
  - Costs
  - Ease of access for people with degree or professional career
  - Flexibility of schedules & workload

- **Disadvantages:**
  - Limited access to a PC or Internet
  - A lack of knowledge of the use of technology

- Such disadvantages are in all kinds of learning
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Service Orientation Paradigm - SOA

- Information Systems (IS) are built to support business processes

- SOA (Service Oriented Architecture) proposes building these systems
  - As an ad hoc collection of smaller modules
  - Called “services”

- These “services” can be shared by more than one IS

- Implementation are hidden from IS
Service Orientation Paradigm - SOA

- SOA implementation are based on Web Services (WS)
- Use on of the Web Service frameworks
  - Based on implementation platforms such as .Net or J2E

- A Web Service is
  - A software system
  - Support interoperable machine-to-machine interaction
  - Over a network

- It has an interface described in a machine-process (WSDL) (Web Service Description Language)
Other systems interact with WS in a manner prescribed
- Using SOAP-messages (Simple Object Access Protocol)
  - Use HTTP with an XML serialization
  - & other Web-related standards

SOA is a much broader concept than WS
- Provides a general framework
- Capable of accommodating the peculiarities and specificities of e-learning

Problem, that broadness
Service Orientation Paradigm - SOA

- OASIS – Organization for the Advancement of Structured Information Standards)
  - Not-for-profit consortium, 1993
  - Created the Service Oriented Architecture Reference Model
    Technical Committee SOA-RM TC

- In 2006 Official Standard OASIS RM for SOA 1.0
- In 2008 “Reference Architecture for SOA”

- The aim of RM
  - Avoid the conflicting definitions
  - Define an abstract model with irrespective of technology
How a RM relates to other work
SOA is defined as a paradigm for organizing and utilizing distributed capabilities.

Organizations create capabilities to support a solution for their problems on their business. However, person’s needs might be met by capabilities offered by someone else.

SOA provides a powerful framework:
- To match needs & capabilities
- To combine capabilities
## SOA paradigm. Key concepts

- **Visibility** – Those with needs & those with capabilities – to be able to see each other

- Interaction is the activity of using a capability – It’s mediated by the exchange of messages

- Use a capability ➔ real world effects. The result of an interaction is an effect
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Service Orientation Paradigm - SOA

- Concept of “service”:
  - The performance of work by one for another
  - The capability to perform work for another
  - The specification of the work offered
  - The offer to perform work for another

- Distinction, capability ⇔ ability

- In SOA, services are the mechanism by which needs and capabilities are brought together
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Service Orientation Paradigm - SOA

- SOA means,
  - Organized solutions
  - Reuse
  - Growth
  - Interoperability

- Under SOA, it offers capabilities and act as service providers

- SOA is commonly implemented using WS, though it can be used other implementation strategies
Service Orientation Paradigm - SOA

- SOA shares many traits with Object Oriented Programming (OOP)

- Although, in SOA the central focus is the task or business function

- SOA-based systems can be visualized as an ecosystem comprising people, machines and services
  - Number of ownership
  - Management
  - Governance issues

- There is not a simple hierarchy of control and management
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Services in Learning

- LMSs provide a suite of tools which support:
  - The creation, the maintenance and the delivery of online courses
  - Enroll and management, students
  - Administration, education
  - Reporting of student performance

- E-learning frameworks provide specification for LMS development with SOA oriented.
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IMS Abstract Framework
IMS Abstract Framework
Open Knowledge Initiative (OKI)

- It is a MIT project that sponsors a SOA-based set of Open Service Interface Definitions (OSIDs)

- OSIDs integrate
  - Many educational applications
  - With a variety of content publishers
  - A widely accepted strategy for repository integration
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LMSs categories

- Open source
  - dotLRN
  - Moodle
  - Sakai
  - ATutor
  - Whiteboard

- Proprietary solution
  - WebCT/Blackboard
  - Gradepoint
  - Desire2Learn
  - Learn.com
LMSs categories

- In Open Source
  - It built upon extendable frameworks
  - Implementers can adjust and modify the LMS

- Similar in proprietary sector
  - WebCT’s PowerLinks kit
  - Blackboard’s Building Blocks
  - Software develops with “hooks” to tie third-party
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LMSs in successive generations

1\textsuperscript{st} Generation

Methods
- Monolithic

Standards
- DC
- RDF
- LRM
- AICC CMI
- LOM
- SCORM
- IMS LIP
- IMS LD
- IMS Enterprise
- ELF
- IMS Abstract Framework

Technologies
- Standalone
- Web-based

2\textsuperscript{nd} Generation

Methods
- Modular

Standards
- IMS Content Package

Technologies
- Adaptive Hypermedia
- Semantic Web

Next Generation

Methods
- Service-Oriented

Standards
- ePortfolio

Technologies
-...

Time
SOA approaches in Higher Education

- Smart (2008) presented at the IMS Global Learning Consortium Summit on Interoperability

- “SOA has a great deal to offer to these institutions, but of all the challenges that remain, the cultural and governance issues seem to me to be the most difficult to tackle”
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Learning with letters

- B-learning, E-learning, M-learning
- U-learning (ubiquitous)
- P-learning (pervasive)
- A-learning (ambience)
- C-learning (capacity)
- T-learning (digital TV)
- V-learning (video or visual)
S-Learning

- Services oriented to e-learning
- A new methodology based on the creation e-learning tools encapsulated in a service-shape
- It can easily integrate into different e-learning platforms
- Reuse services of LMS
- It must only focus on the creation services to be integrated in a very rich environment of services
Example of integration of new services in a LMS
Example of integration of new services in a LMS

LMS
- Portlet: Content
- Portlet: Chats/Forum rooms
- Portlet: Calendar
- Portlet: Intelligent Answering Machine
- Portlet: Evaluation
- Portlet: Practical Knowledge
- Intelligent Answering Machine
- Evaluation
- Labs

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Services in e-learning

- UNED, developing e-learning projects
  - Different services, improving in some way the learning experience

- Virtual learning environment (VLE) used by universities
  - Instructors manage their courses
  - Exchange information with students
  - Long-term courses

- VLE used by corporate setting
  - Courses shorter
  - Only one instructor-led or online session
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Characteristics shared by universities & institutions

- Manage users, roles, courses, instructors, facilities & reports
- Course calendar
- Student messaging & notifications
- Assessment/testing
- Display scores & transcripts
- Grading of coursework and roster processing, including wait listing
- Web-based or blended course delivery
Learning Content Management System (LCMS)

- Systems that focus on
  - the development,
  - Management and
  - Finally published content in a LMS

- Multi-user system
  - Users work with learning content from a central object repository

- Today, LMS is used as a term to encompass the functionality of the LCMS — It is not entirely correct
Learning Content Management System (LCMS)

- LMS is not oriented to
  - Create or manipulate courses
  - Reuse an existing course to create another

- LCMS allow
  - Create courses
  - Import
  - Manage
  - Find and reuse units of learning content (learning objects)
LMS / LCMS

- LCMS provides
  - tools for authoring and re-using or replace content, MLO (mutated learning objects)
  - Virtual spaces

- LMS is often used to refer to both LMS & LCMS

- LMS is software for
  - Planning
  - Delivering
  - Managing learning events
LMS / LCMS

- The focus of an LMS is
  - Manage students
  - Keep track of students’ progress
- It performs administrative tasks, not to create course content
- LCMS is a software for managing learning content
  - Reduce duplicated development
  - A course can be modified and republished for various audiences
  - Allow rapid assembly of customized content
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Reuse of Services

- Internally by LCMS, learning objects
- Externally adding additional services

- New services provide greater robustness

- All the services or packages are almost common to all of the LMSs
Diagram of Services in LMS

- Management Groups & Profiles
- Identification
- Group tools
- Content
- LMS
- Assessment Tools
- BD
- Security
- Communication Tools
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Reuse of Services

- An LMS can generate
  - Different courses
  - Each one with different content

- A content of a course can be used at university or institution

- Possibility to extrapolate it to other places

- A lot of LMSs
  - Commercial & free
  - All use standards but these are not common among them
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Reuse of Services

- A course in a specific LMS adjust to the new LMS

- Situation
  - LMS is equipped with
    - Basic packages
    - Standards and
    - database
  - Handles the content of the courses

- For specific situation would be necessary a new services
Reuse of Services

- A new service could be integrated in some way in the LMS

- Let the new service to
  - Adapt to the growth of the institution
  - Changes of the environment
  - The work done in the first instance valid for next situations

New LMS  New interface of communication  New Service
Reuse of Services

- Independent capsules of LMSs
- Just depending on the environment
- Create generic services
  - For a particular environment
  - Reuse them in the same environments
- Changing the interfaces with the LMS
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Reuse of Services

- Then, LMS has a poor design??
  - The vast majority of current situations can cover all the points

- Important situation → New Virtual environments

- Example, virtual Labs
  - Introduce a system of reserve management
  - Monitor slots of time
  - Labs with real and limited instrumentation
Example of services needed in vLabs

- Identification
- Group tools
- Management groups & profiles
- Assessment tools
- LMS
- Communication tools
- Content
- Communication Interface
- Basic Management
- Reserve Management
- Laboratory
- Hardware
- Simulator
- Logs management
- Security
- BD
- Logs

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Reuse of Learning Object

- Learning object repositories are an effective way of sharing knowledge

- Learning objects are the best attempt to solve
  - The interoperability
  - Reuse
  - Automated updating and
  - Personalization issues
Reuse of Learning Object (LO)

- Search engines are not suitable to find digital resources
- Metadata can obtain additional information that users need
  - Describe the nature and purpose of a LO
- No search through lists of results

Explore collections of LOs
Reuse of Learning Object (LO)

- Resources organized by pedagogical value
- Learning standards:
  - Dublin Core
  - IEEE LOM
- For interoperability across implementations
- Inside communities
  - Adapted to the requirements of their own education system
  - Through application profiles
    - CanCORE
    - LOM-es, etc
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Reuse of Learning Object (LO)

- Courses use in
  - Multiple environments
  - Multiple tools
  - And systems

- SCORM
  - Standardizes how LMS launch & track directed learning experiences

- SCORM package contains a manifest file that
  - Declares its contents
  - Is set up to describe the order in which the sharable content objects (SCOs) are to be delivered
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Reuse of Learning Object (LO)

- Impossible to find single LOs
- LOs are stored in large collections with
  - Tools to view, edit & share their descriptions
  - Tools to retrieve them
- Learning object repositories are accessed by Web Services
- Repositories as web applications. Benefits:
  - Expanded searching capabilities
  - Accurate access
  - Usage statistics
Transfer content of metadata between multiple repositories

- Federated search (FS) layer, middle layer
- Don’t have to modify anything
- In a federated search systems,
  - Queries from users are sent to different Learning object repositories (LORs)
  - FR engine merges the results received by these LORs

- Protocols to reuse repository metadata from external applications
  - OKI
  - OAI-PMH
OAI-PMH: Structure Model

Requests:
- Identify
- ListMetadataFormats
- ListSets
- ListIdentifiers
- ListRecords
- GetRecord

Responses:
- General information
- Metadata formats
- Set structure
- Record identifier
- Metadata

Repository

Data Provider

Service Provider
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Transfer content of metadata between multiple repositories

- Consequences,

- Individual institutions can build their own individual registries

- The global network GLOBE
  - Shares the index of learning resources
  - Available from the five main individual services around the world
  - Users gain access to all the content of all the repositories
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From learning objects to DIGITAL UNIVERSAL OBJECTS

Universal view of digital objects
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Conclusions

- EHEA, framework within which are the IT-based approaches

- This massive and simultaneous redesign
  - Daunting challenges
  - Unprecedented opportunities

- Synergies among the redesigned

- Approaches
  - LCMS
  - Standards: LOM, Dublin Core, QTI, IMS, SCORM
Conclusions

- ECTS facilitates the combination of
  - Face-to-face
  - Distance
  - B-learning

- E-learning → Distance learning
- B-learning → Distance & face-to-face

- E-learning 2.0
  - Influence of current interest
  - Use all the technology available
  - Social and collaborative
Conclusions

- The next generation of e-learning platforms
  - Based on service-oriented visions
  - Framework that encourages
    - Reuse &
    - Sharing of learning contents

- Focus more on
  - Pedagogical & didactical issues of e-learning
  - Knowledge management
## Conclusions

- A framework built on the aforementioned protocols and metadata
  - Interoperability between institutional repositories
  - Improve the resources
  - But, It is not enough to
    - Develop more intelligent, reliable & precise services
    - Connect institutional repository resources with other resources

- Future versions of SCORM & LOM should become
  - Easy to understand
Conclusions

- Legal questions in the field of digital content creation
- Interoperability
  - By standardizing
  - Data management across LMSs
  - A matter of utmost importance
Information Technologies Supporting Learning

Acknowledgements

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Where to find and publish on Technology / Computers on Education?

IEEE Frontiers on Education (October)

- USA based conference
- IEEE (Education and Computer Society) and ASEE collaboration
- Improvement of the Electrical and Computer Engineering Learning
Where to find and publish on Technology / Computers on Education?

IEEE Education Engineering – EDUCON (April)

# Region 8 (Europe, Middle West and Africa) based conference
# IEEE Education Society
# Academic, research and industrial collaboration on global engineering education
Thank you!
Questions for debate?

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