One Step Ahead in the Future of Labs: Widgets, Ubiquity and Mobility

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Education is changing...
Rob Reilly’s “use” in 2011
Games-like
Engaging
AI-ADAPTIVE
Social
Mobile
 augumented
analytics
OPEN
Federated
addictive
Disruptive

Education is becoming ...
One Step Ahead in the Future of Labs: Widgets, Ubiquity and Mobility

Open education new initiatives
OCW was Education Web 1.0
New Web 2.0 Education

LEARN ANYTHING WITH YOUR PEERS.

IT'S ONLINE AND TOTALLY FREE.

At P2PU, people work together to learn a particular topic by completing tasks, assessing individual and group work, and providing constructive feedback.

BROWSE GROUPS & COURSES

START YOUR OWN

CONTENT

INTERACTION

ASSESSMENT

¿CERTIFICATION?

Study Together

Ask questions, give help, and connect with over 100,000 students from 170 countries and 1,600 schools.

Start Studying
An Adaptive open learning

Carnegie Mellon University

Open Learning Initiative
Transforming higher education through the science of learning.

Learn with OLI  Teach with OLI  Get to Know OLI

WHAT WE DO

The Open Learning Initiative offers online courses to anyone who wants to learn or teach. Our aim is to combine open, high-quality courses, continuous feedback, and research to improve learning and transform higher education. Learn More

Active Learning
Throughout our courses, students encounter activities, simulations, and virtual labs to help them apply and test their learning.

Learn More

Learn to code

Codecademy is the easiest way to learn how to code. It's interactive, fun, and you can do it with your friends.

Get Started (It's Free)
Massive On-line Open Courses

MITx  MIT's new online learning initiative

Coursera

PRINCETON UNIVERSITY  STANFORD UNIVERSITY  UNIVERSITY OF MICHIGAN  Penn

IE  MIT  edX  HARVARD UNIVERSITY
How about Certification on those open environments?

Self-accreditation & identity?

**badges** = visual representations of a *skill* or *achievement*
Mobile and augmented learning...
Today I woke up to find that my car had been broken into. I was upset about not hearing my car alarm go off, until I realized that it had gone off in the middle of the night. I had woken up and cursed the idiot who had set off the alarm, put a pillow over my head, and fallen back to sleep. FML.

Today my friends and I were drinking boba, a type of East Asian tea. On the side of the cup it said, “Please drink carefully to avoid choking on the boba.” I started to laugh at the ridiculousness of the label and proceeded to choke on the boba in a coughing fit. FML.

Today I babysat three-year-old twins. They have a huge dry-erase board hanging between their beds. After they fell asleep, I was bored and drew a very large, detailed penis on the board. When I went to erase it, I realized I had used a permanent marker. FML.

Today my child told me, “Mommy, it goes up like a stick.” I said, “Well, it’s okay.” Then I asked when it does that, and she said, “When I’m watching Scooby-Doo dressed in lady clothes.” FML.

Today I met a really nice couple. The conversation eventually drifted, and the man commented that hooking up was so pathetic. They had met on MySpace.

Today I was giving my boyfriend a blow job. Nothing was going into my mouth. I then realized I had forgotten to put something in my mouth. FML.
Enriched ebooks
Location-based AR

- Location of institution facilities: CSEV AR
- In-situ collaborative Learning: leARnengineering
Location-based AR to learn History
Gamification
Education should not be fun, it should be addictive!
The importance of...

Learning analytics
Learning analytics

- Data mining students learning performance to adapt and personalized contents and services
How these new initiatives impact on engineering education?
What happen with our resources?

- Existing resources:
  - Virtual & Remote Labs
  - Simulations
  - Video-lectures
  - Assessment
1) Should be easily reused into the new initiatives

- iBook
- Enriched eBook
- iTunesU
- Massive on-line courses
- P2P learning environments
2) Should be shared by other institutions

- A federation of resources is needed to orchestrate the resources sharing
- APIs offered to share learning analytics
- Sharing policies applied
3) Should work on any device

- Resources built or adapted using cross-platform technologies such as HTML5
- Reduce reprogramming efforts
4) Should be more engaging

• Apply some game-like elements to our experiments
  – Karma
  – Levels
  – Badges
  – Points
  – Story-telling
  – Realistic cases
  – …
  – Confrontation
  – Collaboration & Fighting
5) Should be more secured

• With identification technologies
  – or along with traditional username & Password (identification)
• Such as,
  – Biometrics
    • Multi-biometrics
  – RFID
  – Combination
• Multiple identities?
• Digital identities?
But we have a long way to walk...

- Challenges -
Online Labs as Open E-learning Resources

- Traditional laboratories were the only possibility that allowed students to carry out experiments and get the needed skills for their future jobs

- The improvement in communication networks and programming languages were key factors in the evolution from traditional Laboratories to online Labs
Online Labs as Open E-learning Resources

• Currently, there are a great number of Virtual and Remote Labs on Web

  – **Virtual Web Labs** → Virtual web labs are applications installed in a web server and accessed over Internet

  – **Remote Web Labs** → are applications which allow student to manipulate hardware through a Web browser over Internet
Online Labs as Open E-learning Resources

Virtual and Remote Labs are not mutually exclusive. They can be combined in the learning process. For instance:

- A Virtual Web Lab can be used to teach students how to handle the instruments and carry out tasks that can damage these.
- A Remote Web Lab can be used when students have learnt of management of instruments.

- A new resource to consider inside Blended Learning !!!!
Online Labs as Open E-learning Resources

- Virtual and Remote Labs can be used in many educational fields, such as:
  - Electronic and Control
  - Electrical Engineering
  - Chemistry
  - Physics
  - Anatomy
  - Biology
  - Education
  - ...
Examples of Virtual and Remote Web Labs

• Chemistry

The Iowa State University provides a set of Virtual web Labs in Flash where students can carry out experiments about electrochemistry, gas laws, stoichiometry, and acid-base equilibria.
Examples of Virtual and Remote Web Labs

- **Anatomy**

The Stanford University provides a set of online interactive media to teach human biology

http://virtuallabs.stanford.edu/
Examples of Virtual and Remote Web Labs

- Circuit analysis and electronics

Visir project developed by Blekinge Institute of Technology (BTH) in Sweden that has created a lab workbench equipped with a unique remote control interface, enabling students to perform physical experiments at home or elsewhere.
Examples of Virtual and Remote Web Labs

• Physics

Force On a Dipole Experiment from MIT. This Remote Lab consists of a small magnet suspended vertically by a spring in the center of two horizontally mounted coils.
Virtual and Remote Web Labs In
INTERNET
Sharing Virtual and Remote Web Labs

Currently, there are two main solutions:

- Shared architectures
  - iLab Shared Architecture (ISA)
  - WebLab-Deusto Architecture
  - SAHARA

- E-learning standards
  - W3C’s Resource Description Framework (RDF) & Dublin Core (Lab2go)
  - SCORM (LILA)

IEEE Education Society Working Group on “Standard for Networked Smart Learning for Online Laboratories” (PAR No. P.1876)
Sharing Virtual and Remote Web Labs

Shared architectures provide a unifying software framework that can support access to a wide variety of online laboratories. Users and the online laboratories can be globally distributed across an arbitrary number of locations linked only by the Internet

- iLab Shared Architecture (ISA)
- WebLab-Deusto Architecture
- SAHARA
Examples of Shared Architectures

iLab Shared Architecture (ISA)

Batch Experiments

Interactive Experiments
Examples of Shared Architectures

iLab Shared Architecture (ISA). At this moment is implemented in:

- Africa (Uganda, Nigeria, Tanzania)
- Asia (China)
- Europe (Austria, Stuttgart, Brasov, ...)
- Australia (Queensland, Melbourne)
- USA (Massachusetts)
Examples of Shared Architectures

WebLab-Deusto Architecture
Examples of Shared Architectures

WebLab-Deusto Architecture is implemented in:

- Deusto
- DIEEC (UNED)

Some of the laboratories are:

- FPGA
- Visir
- Managing a Robot
Examples of Shared Architectures

SAHARA provides a network of remote laboratory that could be used by all Australian Universities.
Examples of Shared Architectures

SAHARA is being used by:

– Curtin University of Technology
– Queensland University of Technology
– RMIT University, University of South Australia
– The University of Technology, Sydney
Virtual, Remote Web Labs and Shared Architectures in INTERNET

Therefore:

– Students of universities that have implemented some of the shared architecture are able to reuse Virtual and Remote Labs of other universities
Virtual, Remote Web Labs and Shared Architectures in INTERNET
Challenges of Shared Architectures

• Currently these architectures are not able to speak (too much) each other. It is necessary to:

  – sponsor the design of an efficient mechanism for sharing, exchanging and trading access to online labs by creation of a global network of shareable experiments
  – lead the evolution of an architecture that enables the sharing of online labs by unified standards
Challenges of Shared Architectures

• These challenges are being undertaken by

GOLC
Global Online Laboratory Consortium
Challenges of Shared Architectures

• The Global Online Laboratory Consortium is composed by a great number of members, such as:
  - University of Technology, Sydney
  - Massachusetts Institute of Technology
  - University of Deusto
  - University of Stuttgart
  - Carinthia University of Applied Sciences
  - UNED
  - Makerere University
  - Technische Universität Graz
  - The University of Queensland
  - TU Dortmund University
  - School of Engineering - Polytechnic of Porto
  - Universidad EAFIT
  - College of the North Atlantic Qatar
  - Obafemi Awolowo University
  - Nanyang Technological University
  - RMIT
  - Blekinge Institut of Technology
Using E-Learning Standards

The use of E-learning Standards make easier:

- Interoperability → offer e-learning resources on different platforms

- Migration among different versions of e-learning platforms

- Search and Reuse of E-learning Resources
Using E-Learning Standards

Some of well-known e-learning standards are:

- Dublin Core & LOM IEEE. Both define a set of metadata which allow describing e-learning resources.

- IMS Content packaging & SCORM. Both define how to pack e-learning resources to create more complex e-learning objects.
Using E-Learning Standards

– IMS Learning Design supports the use of a wide range of pedagogies in online learning

– IMS Question and Test Interoperability describes a data model for the representation of question (assessmentItem) and test (assessmentTest) data and their corresponding results reports
Virtual and Remote Web Labs are enriched e-learning resources and therefore can be used with e-learning standards.
E-Learning Standards & Online Labs

• Some example of the use of e-learning standards and Online Labs are:
  – Lab2go Project
  – LILA Project
E-Learning Standards & Online Labs

- Lab2go project has created a generic model ontology consisting of various properties to add laboratories such as remote laboratories, virtual laboratories, experiments, access URL, status, cost, release date, languages, description, administrator, etc.
  - This project adopts basic terminology and data types from Dublin Core
E-Learning Standards & Online Labs
E-Learning Standards & Online Labs

- LILA project. Consists of a web server running the LiLa portal and a database for keeping the experiments, and a second database for the booking and reservation time slots and the corresponding booking and reservation codes. Experiments are, as already described earlier, represented by SCORM packages.
### LiLa Content

The following list represents the initial content to be integrated into the LiLa environment. The project is open for additional content providers.

<table>
<thead>
<tr>
<th>Content</th>
<th>Description</th>
<th>Type</th>
<th>Content Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>VideoEasel</td>
<td>Laboratory for statistical mechanics, about 90 experiments (magnetism, lattice gas, population dynamics, oscillating reactions...)</td>
<td>Virtual Lab</td>
<td>Rechenzentrum Universität Stuttgart</td>
</tr>
<tr>
<td>Remote Farm</td>
<td>16 experiments (magnetism, electrical oscillator, Raman-Spectroscopy...)</td>
<td>Remote Experiments</td>
<td>Technische Universität Berlin</td>
</tr>
<tr>
<td>Cambridge WebLabs</td>
<td>Two setups: combustion flame experiment &amp; reactor web-lab</td>
<td>Remote Experiments</td>
<td>University of Cambridge</td>
</tr>
<tr>
<td>SRM web-suite</td>
<td>Combustion engine simulations</td>
<td>Simulations</td>
<td>Computational Modelling Cambridge Ltd.</td>
</tr>
<tr>
<td>LiTen</td>
<td>Optical properties of thin films, Nanomechanical properties of thin films, Nanotopography</td>
<td>Remote Experiments</td>
<td>Aristotle University Thessaloniki</td>
</tr>
<tr>
<td>NanoWorld</td>
<td>Six setups: Virtual pharmacy experiments, electro chemistry, fluorescent dipoles, atomic flat silicon surfaces...</td>
<td>Virtual Experiments</td>
<td>Universität Basel</td>
</tr>
<tr>
<td>NanoWorld</td>
<td>Nine setups: Remote atomic force microscope, data acquisition of sensors, harmonic oscillator,...</td>
<td>Remote Experiments</td>
<td>Universität Basel</td>
</tr>
<tr>
<td>OMNotebook</td>
<td>An electronic notebook based on the programming language Modelica, suitable for Multi-domain acausal simulations, e.g any type of system that can be described by coupled differential equations (flight simulation, racing car, robots, automatic gearbox and many more)</td>
<td>Simulations</td>
<td>Linköpings Universitet</td>
</tr>
</tbody>
</table>
Challenges of E-Learning Standards & Online Labs

Structure of SCORM Package
Challenges of E-Learning Standards & Online Labs

• Although SCORM is used to pack e-learning resources. Several issues must be considered:

  – The packaging of rich multimedia and interactive e-learning content is restricted by current online learning environment that uses SCORM
  – SCORM should have an authentication mechanism, particularly to Protect Assessment Data
  – SCORM should use current programming standards. It is recommended that SCORM use a RESTful API to decentralize the architecture
Challenges of E-Learning Standards & Online Labs

• To mash-up, nowadays Internet is a set of services, applications and infrastructures
E-Learning Standards & Online Labs

• Therefore new e-learning standards are being developed such as Next Generation SCORM focus on:

  – Tracking of detailed learner interactions and learner performance characteristics that are richer in scope and depth than assessments involving score thresholds

  – Tracking of out-of-browser content to include games, simulations, virtual worlds and mobile apps
E-Learning Standards & Online Labs

– Launching and tracking of multi-modal content that renders intelligently based on device (ex. tablet, smart phone, laptop) not only in LMS

– Accessing to learner data during or after the learner experiences the content

– Hosted content via a content as a service (CaaS) model
E-Learning Standards & Online Labs

The e-learning resources such as assessments, files, applications are in Learning repositories.
E-Learning Standards & Online Labs

- Smart devices
- Web pages
- Assessments

Web

Linking (mashup)

Upload & establish an API to exchange data and track learners

IEEE

International Conference REV

UNED
Online Labs & Education

Virtual and Remote Web Labs are e-learning resources, and they must be used along with other e-learning resources & services, such as:

- Assessments
- Forums
- User tracking
- Tutorials (Web, PDF, etc.)
Online Labs & Education

- As it has been SCORM can be used In LMS SCORM Complaint

- Other possibility is that Virtual, Remote Web Labs and Shared architecture provide a set of APIs and these can be used by e-learning systems
Online Labs & Education

Diagram showing the architecture of online laboratories and education systems, including components like Internet, Middleware, LMS, Broker Server, Database, Controller, Instruments, and Software Lab.
Online Labs & Education

• To do this, the main idea is to create an activity or module in a LMS (the less code possible to allow being translated to some LMS)

• And the main goal is to split the creation of learning scenarios in different roles
Online Labs & Education

Diagram:

1. **Manage Laboratories (within LMS)**
   - Add laboratory (description, connection data, etc.)
   - Modify data of laboratory
   - Delete data of laboratory from LMS

2. **Manage Laboratories (in a LMS course)**
   - Add
   - Delete

3. **Display Laboratory in the course**
   - Access to Laboratory

4. **User Interface**
   - LMS Administrator
   - Teacher
   - Student
Online Labs & Education

• This idea has been developed for DIEEC from UNED

• This idea is evolving new concepts and issues such as:
  • Use of new e-learning standards
  • There are institutions which use other e-learning system and free courses and communities
Online Labs & Education

• **Massive** open online course (MOOC) and free learning communities

  - MITx will offer a portfolio of MIT courses for free to a virtual community of learners around the world
Online Labs & Education

- COURSERA provides courses from universities such as, Princeton or Stanford, for free.
Online Labs & Education

- Udacity → provides courses where students learn solving challenging problems and pursuing projects with world-renowned university instructors

Meet Udacity!

Udacity is a totally new kind of learning experience. You learn by solving challenging problems and pursuing audacious projects with world-renowned university instructors (not by watching long, boring lectures). At Udacity, we put you, the student, at the center of the universe. Keep Reading

The Four Elements of Udacity

1. Take any of our 11 classes, 100% free!
2. Join a community of 112,091 active students and instructors. 100% free!
3. Optionally certify your skills online or in one of our 500 testing centers, for a fee.
4. Optionally let us find your resume to one of our 28 partner companies. 100% free for students!
Online Labs & Education

- Harvard University and the Massachusetts Institute of Technology (MIT) have developed edX. The two institutions will collaborate to enhance campus-based teaching and learning and build a global community of online learners.
Online Labs & Education

- UNED, Massachusetts Institute of Technology, CSEV, Telefonica and Banco Santander are collaborating on a project of higher education on line for Spanish- and Portuguese-speaking countries to simplify and have easy Industry-related activities and collaborative environment in economics activities.
Online Labs & Education

• Virtual and Remote labs must be able to be elements of these courses and communities
  • Challenges, such as:
    • Open access
    • Security
    • Ubiquity
    • E-learning Services
• Must be reconsidered with new ideas, Standards and architectures
New Ideas to Create Online Labs

According to IEEE Technology Time Machine, several ideas and concepts must be considered:

- IoT
- Cloud (Service) Computing
- Mobile and ubiquitous systems
- Security
- Smart Grids
- Health & Biosystems
New Ideas to Create Online Labs

“Internet of Things (IoT) refers to the vision that in the next 20 years, a revolution in device-to-device communication will take place that will be comparable to the revolution in person-to-person communication that erupted in the last two decades with the Internet and World Wide Web”
New Ideas to Create Online Labs

We will be able to browse I or “things” just as today we search for information. We will be able to create environments out of things, just as today we can mash up services and information.

This “things” have embedded intelligence, an embodiment of the IoT can function quite autonomously, making decisions and taking actions that would normally require human activity.
New Ideas to Create Online Labs
Security in e-leaning systems

Biometric & Fingerprint
Biometric Technology

• According to “Biometric Market Forecast to 2014”, biometric technologies:
  – Widely accepted
  – Adopted in POS, ATM, border security and so on
Biometric Technology

Fingerprint recognition dominates the world market of biometric technology
Biometric Technology

- Companies search for application with a fast integration

- The biometric authentication security architecture multilayer would be the future of network security
Biometric at Labs

• Combination of Labs and technology emergent

• Exams by Internet – NEED an automatically control module
Biometric at Labs

• BUT, practical activities with real instrumentation by Internet – NEED a biometric system

   – For his own benefit

   – For the institutions'
Generic Diagram of Biometric for example uses of Fingerprint
Biometric at Labs

• Traditional authentication (IDN, password, ...) + Biometric
• LMS to connect us with Labs – such as Moodle

• Case of study
  – Moodle (user name + password) & Biometric
Biometric at Labs

• New login
  – Biometric sample stored in Moodle DB
    • At enrolment – it is stored
    • Login – match it in every access

• New files and changes in login/ folder
• A new field (Biometric sample) in mdl_user table of DB Moodle
Biometric at Labs – How?
Biometric at Labs – Real case

- Date – June, 2010
- Seek – receptivity of the users
  - The use of biometric control as a method of verification
- Sample size – 23 students
- In the segment from 26 to 35 years old
- With a college degree
## Biometric at Labs – Real case

### Most important Q/R in the Survey about E-learning activities

<table>
<thead>
<tr>
<th>Questions</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>How do you consider the register via fingerprint to access to the courses in Moodle?</td>
<td>47.8% students consider it is convenient or very convenient</td>
</tr>
<tr>
<td>If you had to choose one biometric technology to access Moodle courses, which one you would choose?</td>
<td>52.2% Fingerprint</td>
</tr>
<tr>
<td>Do you consider that it was easy to access the course in Moodle using fingerprint verification?</td>
<td>78.3% easy or very easy</td>
</tr>
<tr>
<td>How would you consider your knowledge of biometrics?</td>
<td>60.9% without knowledge level</td>
</tr>
<tr>
<td>Have you ever used the biometric access control?</td>
<td>73.9% Never</td>
</tr>
</tbody>
</table>
Biometric at Labs – Real case

- Results – a positive trend of the use of biometric control as a way of access to e-learning activities

- Safer, easier and faster

- Some biometric technologies are integrated in our laptops – best-known
Biometric in High Education – Future project

• Challenge:

Convert the distance into an advantage
Biometric in High Education – Future project

- Future project – Face recognition

  - Key – Biometric systems, more than a control system

  - Intelligent control of emotions
    (angry, worried, happy, etc.)
Biometric in High Education – Future project

- DIEEC website as a tool for students
- Interactive display at information point at Industrial Engineering School
Biometric in High Education – Future project

- Robots to interact with children with disabilities
Biometric in High Education – Future project

- Serious Games
- 3D Animation for educational purposes
Ubiquity in e-learning systems

Future Technologies for Engineering Education

Mobile devices

http://ohm.ieec.uned.es/portal/
Mobile devices

• Some experiments are made with technologies not supported by mobile devices:
  – Flash on iOS devices
  – Microsoft Silverlight
Mobile devices

• Some experiments do not make sense to use them in a mobile device:
  – Because you have to program or compile something (a file) previously with a computer-based tool
    • e.g., microprocessor remote lab
  – Because screen is too small
    • Tablets could help
Mobile devices

• Ways of using experiments on mobile devices:
  – Native app (iOS or Android) for the experiment
    • Provides more control over the device capabilities
    • Expensive to create and maintain
    • Specific development for each platform
Mobile devices

• Ways of using experiments on mobile devices:
  – Integrated on an enriched ebook
    • It allows its use together with the theory and assessment
  – Web-based experiment adapted to mobile device
    • Reduces development efforts
Mobile Web adaptations

• Provide a proper layout. Developers should think what is actually going to be used from a mobile device, and how may the user see it in a small screen.

• Provide the required contents. Developers should think what contents are going to be migrated to the mobile version.

• Avoid plug-ins. Some plug-ins are not available in all devices, such as Flash or Microsoft Silverlight.
What will the future bring?

According to IEEE Technology Time Machine several ideas and concepts must be considered:

- Network (Service) & Cloud Computing
- Collective Intelligence
- Media & Inmersive
- Smart Power
- Transportations
- Health & Biosystems
What will the future bring?

- Cloud computing & Internet of Things
What will the future bring?

Cyber Physical Systems. Complex systems can be characterized as composed of heterogeneous components and in particular electromechanical, thermal, computing, and communication elements.
What will the future bring?

- **Collective Intelligence** emerges from collaboration and competition of multiple individuals

  “In a changing and dynamic world, high-resolution and timely geospatial information with global access and coverage becomes increasingly important”
What will the future bring?

Future Connectivity and networks ➔

• we will have faster connectivity, both wireless and wireline, we will be using cell phones and other devices, we will be living in a world
• seamless ubiquitous access to information and services
What will the future bring?

- Future of Media
  - How will information be acquired, paid, and distributed in the future
  - What is the impact of ubiquitous connectivity and connected users on future developments
IEEE EDUCATION SOCIETY

- IEEE Education society is interested in:
  - Educational methods
  - Educational technology
  - Instructional materials
  - Accreditation
  - History of science and technology
  - And educational and professional development programs within Electrical Engineering, Computer Engineering, and allied disciplines
To do this, IEEE education society organize and support several conferences:
IEEE EDUCATION SOCIETY

TAEE 2012  13-15 June  Vigo, SPAIN

ICL 2012  21-23 September Villach, AUSTRIA

ITHET 2012  21-23 June  Istanbul, TURKEY

ICELIE 2012  25-28 October  ÉTS, Montréal, CANADA
IEEE EDUCATION SOCIETY

- IEEE education society provides a set of publications, such as:
  - IEEE Transactions on Education
IEEE EDUCATION SOCIETY

– IEEE Learning Technologies

– IEEE-RITA Revista Iberoamericana de Tecnologías del Aprendizaje
IEEE EDUCATION SOCIETY

– The Interface—joint publication with ASEE

– IEEE Technology and Engineering Education (ITEE)
IEEE EDUCATION SOCIETY

– BUT IEEE as Conferences and Publications and Services provider must be changing as the time is changing:

• Virtual worlds and virtual conferences
• Immersive conferences
• Open content publication
• Enriched and immersive publications

allowing INTERACTIVITY and OPEN ACCESSIBILITY
Conclusions

Mashup of acronyms, letters, technologies ...

Some initiatives has been developed to SHARE laboratories and be used in learning management system
- iLab, Labshare, WebLab-Deusto
- LILA, UNED (DIEEC) Project

our PhDs will be the future with our help
Conclusions

But new issues must be considered to:

• Should work on any device, such as (e-books, smart phones, tablets, PCs, etc.)
• Should be used along with other e-learning services and different platforms (LMS, Massive online Courses, etc)
• Should be shared by other institutions. Ideas such as Cloud computing, new e-learning and Internet of things must be considered
• Should be more secured (biometric methods) and certified
ACKNOWLEDGMENT

• European Funded projects RIPLECS “Remote-labs access in Internet-based Performance-centred Learning Environment for Curriculum Support” 517836-LLP-1-2011-1-ES-ERASMUS-ESMO

• PAC PAC - Performance-centered Adaptive Curriculum for Employment Needs - 517742-LLP-1-2011-1-BG-ERASMUS-ECUE

• e-Madrid Project, S2009/TIC-1650, “Investigación y Desarrollo de tecnologías para el e-Learning en la Comunidad de Madrid”

• DIEEC/UNED team: Elio / Mohamed / Alberto / Gabi / Sergio / Maria Jose / Clara / Charo
One Step Ahead in the Future of Labs: Widgets, Ubiquity and Mobility

Thank for your attention
Comments? Questions?

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