Remote-labs access in Internet-based Performance-centred Learning Environment for Curriculum Support RIPLECS

Progress Report first year Public Part

517836-LLP-1-2011-1-ES-ERASMUS-ESMO

Project information

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Executive Summary

RIPLECS project is a project for definition and development of a telematics based European infrastructure and organisation for ICT curriculum, providing a range of co-authoring, co-learning, simulation- and laboratory practice-based learning facilities.

Target groups: Students in the field of technology and engineering. With the integration of telecommunication technologies and computer science with virtual instrumentation, real, remote laboratories will be developed and accessed through Internet in real time, ensuring a richer collaborative experience for the student while avoiding some of the growing limitations of traditional laboratories, such as the lack of enough work area, expensive instrumentation, lack of personnel, time assigned to a laboratory, and their availability in non-working office hours. Teachers in higher education in the same field. They need methods and tools, integrated in a system that will design, develop and present learning resources for an educational process, that is characterized with providing just-in-time, just enough and at the point of need support to learners in order to deal with complex authentic tasks in the context of problem-based learning. University management is convinced of the necessity of European dimensions in higher education, particularly with regards to curricular development, interinstitutional co-operation, virtual mobility of students and academic staff, and integrated programmes of study, training and research.

The consortium unites universities teaching engineering and science, and open universities. It encompasses members from four countries with four different languages and from different application domains, including mathematics, physics, microelectronics, information technology and telecommunications. The partnership:

- Has experience in applying performance-centred approach in different educational and training contexts: regular university education, training and qualification, and community education;
- Collaborated successfully in the previous projects and in the development and use of the IPSS system in eLearning.

The RIPLECS project aims at developing a system to enable real-world experiments remotely in an e-learning context of “Information and Communication Systems (ICS)” curriculum. The students will be able to interact with the remote experiment, change parameters and in some cases modify and design experiments. The network architecture of RIPLECS platform enables the world-wide distribution of resources, in terms of lab-experiments, by utilizing multiple Web servers in a single network topology. Thus, instructors from different European countries can take the advantages of employing a running lab-experiment and present it in their native language and personal educational point of view.
With the integration of telecommunication technologies and computer science with virtual instrumentation, real, remote laboratories can be developed and accessed through Internet in real time, ensuring a richer collaborative experience for the student while avoiding some of the growing limitations of traditional laboratories, such as the lack of enough work area, expensive instrumentation, lack of personnel, time assigned to a laboratory, and their availability in non-working office hours.
The project intends to create an European Master Degree in Information and Communication Systems, which will start by the end of the project and will be delivered as many years as the labour market needs ICT specialists and students want to enrol for the MSc degree curriculum.
Web Page http://riplecs.dipseil.net

Table of Contents

1. Project Objectives

The aim of the RIPLECS project is the definition and development of a telematics based European infrastructure and organisation for ICT curriculum providing a range of co-authoring, co-learning, simulation- and laboratory practice-based learning facilities. The RIPLECS project aims at adapting DIPSEIL system to enable real-world experiments remotely in an e-learning context of “Information and Communication Systems (ICS)” curriculum.

The goal in a concrete manner is a realization of practical tasks performance in courses from the complete master degree program through remote access to laboratories.

Objectives:

1. Identification of user needs in practical ICT education and translation into functional specifications of Remote-labs access in Internet-based Performance-centred Learning Environment for Curriculum Support (RIPLECS).
2. Development and validation of a prototype of the telematics based ICT educational service - RIPLECS
3. Experimental study on the use of a new instrument ‘Remoteness’ in IPLECS environment through practical tasks performance.
4. Analysis of RIPLECS organizational, technical and quality related issues in order to share content, support virtual students’ mobility and improve students’ achievements to gain qualifications and competence.
5. Identification and dissemination of best practice pedagogic approaches for the use of telematics and multimedia technologies in ICT education.

Target groups: Students in the field of technology and engineering. With the integration of telecommunication technologies and computer science with virtual instrumentation, real, remote laboratories were developed and accessed through Internet in real time, ensuring a richer collaborative experience for the student while avoiding some of the growing limitations of traditional laboratories, such as the lack of enough work area, expensive instrumentation, lack of personnel, time assigned to a laboratory, and their availability in non-working office hours
Teachers in higher education in the same field. They received methods and tools, integrated in a system that will design, develop and present learning resources for an educational process, that is characterized with providing just-in-time, just enough and at the point of need support to learners in order to deal with complex authentic tasks in the context of problem-based learning.
University management is convinced of the necessity of European dimensions in higher education, particularly with regards to curricular development, interinstitutional co-operation, virtual mobility of students and academic staff, and integrated programmes of study, training and research.
During the reporting period: Teachers were involved in remote labs access development together with software and hardware developers. They were involved in the field trial.
The following activities in which the first two target groups were involved in the first year are: secondary research, surveying activities (inc. formal and informal interviews); feedback to the project coordinator and local coordinators; meetings, discussions. In the needs analysis phase, the project applied the interviews and study research.
University management was involved during the first year in the activities for organization of European Master degree in ICS.

The impact: The RIPLECS project aims at developing a system to enable real-world experiments remotely in an e-learning context of “Information and Communication Systems

(ICS)" curriculum. The students can interact with the remote experiment, change parameters and in some cases modify and design experiments. The network architecture of RIPLECS platform enables the world-wide distribution of resources, in terms of lab-experiments, by utilizing multiple Web servers in a single network topology. Thus, instructors from different European countries can take the advantages of employing a running lab-experiment and present it in their native language and personal educational point of view. Obviously, each supervisor has the opportunity to review his users' performance by his own criteria, according to the assessments rules for each experiment, which are defined in the RIPLECS application server.

With the integration of telecommunication technologies and computer science with virtual instrumentation, real, remote laboratories can be developed and accessed through Internet in real time, ensuring a richer collaborative experience for the student while avoiding some of the growing limitations of traditional laboratories, such as the lack of enough work area, expensive instrumentation, lack of personnel, time assigned to a laboratory, and their availability in non-working office hours.

2. Project Approach

Project Approach for the Management of the project:
Aims: To keep track of the project; To provide version control mechanisms and a common archiving procedure; To provide correct reports following the administrative handbook.
Tasks and activities. Planning: Establish a detailed management plan and define milestones; Perform reviews at the milestones and analyze delays; Re-schedule tasks in case of delays or problems; Use the time plan as a basis to control the work of all partners.
Configuration Management - Project Management Centre set-up: Internet-based, teamwork system with defined working scenarios for project management, quality management, work package management, and deliverable production and review; Partners and EACEA have online access to the project.

Project Approach for the Needs analysis:
Aim: Development of 'Remoteness in IPLECS' conceptual model operationalising the concept of remote access to real laboratories in IPLECS environment
Objective: Identification of user needs in practical ICT education and translation into functional specifications of Remote-labs access in Internet-based Performance-centered Learning Environment for Curriculum Support (RIPLECS)
Tasks: We performed needs analysis in two main aspects:

1. Identification of user needs in practical ICT education, which means that we defined skills, knowledge and competences that need practical experiments and work in labs from the developed 'Information and Communication Systems' (ICS) curriculum. We identified the tasks from the modules of ICS curriculum that need practical performance in real labs. During this process we made a review of the curriculum and analyzed the needs to upgrade, rework, or develop some courses – add new tasks for performance to the modules from the courses, integrate in the DIPSEIL data-base new courses (for example to the list of elective courses), or change the learning resources
2. Specification of remote labs access – design considerations, architecture, software and hardware solutions, human resources decisions.

For the needs analysis we used experts group decisions, case studies, literature study
Together with this: activities in ICS curriculum upgrade: consult the Universities mission statements, general education learning outcomes, department initiatives, budgetary support, for assistance in preparatory activities; Process flowchart, overview, submission deadlines and schedule; Courses specification – consideration, recommendation and approval from the team and review team from different universities; Prepare documents – Program development form, Course outline form, syllabus form, action verb list for learning outcomes for each course; Admission and qualification requirements.

Project Approach for the Development of Remote-labs access in IPLECS:
Aim: to realize the remote access to the labs in five partners organizations, for the practical tasks performance identified during the needs analysis. To integrate the 'Remoteness' as a new instrument in IPSS with educational elements previous developed and available for the partnership.
Objective: Development and validation of telematics based ICT educational service – RIPLECS
Tasks: The RIPLECS development is based on three main components (excluding the user and the Internet): web server, lab-server and the remote laboratory infrastructure.
1. The Web server hosts the course management software – DIPSEIL, processes all the actions by the learner, and establishes the link with the Lab server. The development and maintenance of a laboratory class can be merged into a single database system embedded in DIPSEIL platform. In IPSS lab-exercise is equal to a practical task performance (PTP). One PTP may consist of several active-images, which correspond to the real lab-circuits. For

each lab-circuit, test-points and active-elements can be assigned. Hardware properties required for the assignment of the test-points and the active-elements are specified in the custom abstract language. On the other hand, to a PTP different instruments can be assigned - information, regarding the theoretical and practical aspects, instructions, expert advices, references. Communication between the user application and the Web server uses HTTP protocol.
2. The Lab server hosts a range of experimental related hardware and software tools required to carry out practical experiments and controls the laboratory equipments. The hardware components of a Lab server include test instrumentation and experiment boards.
3. The hardware for the project consists of experiment boards and laboratory instruments.
4. The next step in building the remote lab was the creation of graphical user interface (GUIs) that allows the control of accessories as well of data acquisition and generation. The user interface consists of three sections including, configuration, send data and receive data. The user only requires a web browser and a software plug-in in order to carry out the experiments. Inside the interface the user is presented with various controls and displays, depending upon the current practice and circuitry available.
5. Finally the remote lab includes a digital camera for the visually observation of the experiment. A webcam allows users to see the equipment and to monitor the execution of their command.

Project Approach for the RIPLECS evaluation:
Based on current advancement in the domains of curriculum design, instructional design and software engineering design, the evaluation strategy of the RIPLECS project further develops the Design Research as the project's overarching evaluation methodology. (Brown 1992; Collins, Joseph and Bielaczyc, 2004; Arnowitz, Arent and Berger, 2005; Holtzblatt, Wendell and Wood, 2007; Kuniavsky, 2003). The reasons for selecting design research as an overall evaluation methodology are as follows: (a) the RIPLECS project includes a software engineering design to develop the RIPLECS system and a curriculum and an instructional designs to prepare courses within the RIPLECS; (b) curriculum design, instructional design and software engineering design work under the same design philosophy, that is developing solutions, prototypes, or systems in a iterative process of collecting empirical evidence on their effects in real-life context, reflecting on it and incrementally refining and improving these interventions; (c) evaluation is not the last step of the design process, rather it cuts across all other stages: needs analysis, development of mock-up and prototype, and implementation of the system in the practice; (d) the RIPLECS evaluation methodology triangulates different data collection methods, qualitative and quantitative (walk-through- the- system, heat maps, interviews, experiments, questionnaire, and learning achievement test) and qualitative and quantitative data analysis techniques,(Grounded Theory Approach, computational linguistic, card sorting and hierarchical cluster analysis).

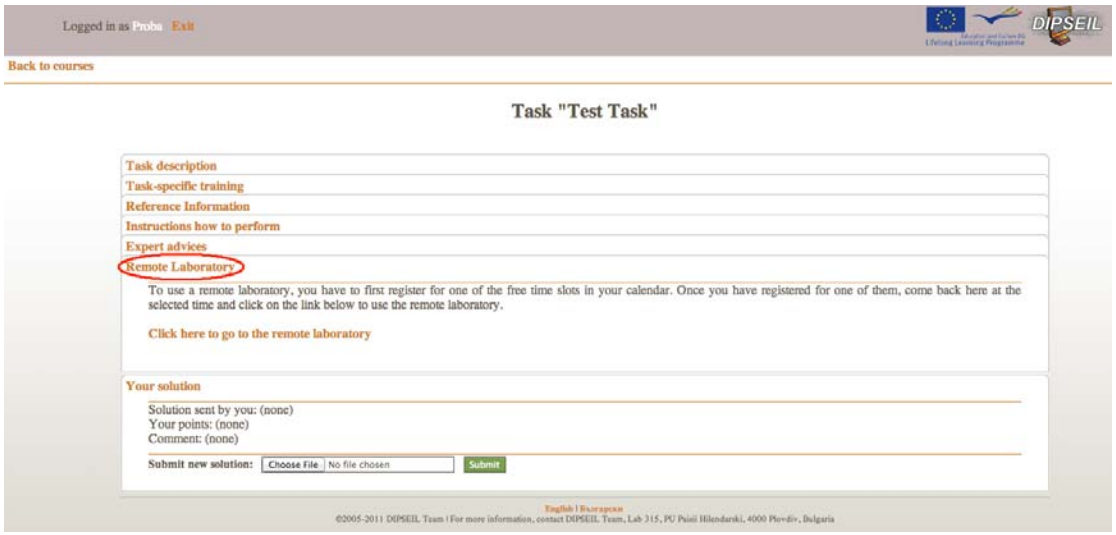
3. Project Outcomes & Results

Needs Analysis Report in five parts – needs analysis reports for remote access at five partners universities. (Web page, Project results)

Remote Labs at five universities – descriptions of the five remote labs are presented on the Web page, Project results section (TUG Remote lab, TUS Remote lab, PU Remote lab, CIT Remote lab, UNED Remote lab). Here we present the technical development and organization of the remote labs implementation:

The goal of RIPLECS project is to offer remote access to already existing laboratories. Well equipped technical laboratories cost often a lot of money and many universities and organizations do not have enough funds to equip laboratories in different fields of the science. By providing remote access to these, consortiums of organizations may use each others already bought technologies to support their studies through practical, real-life situations.

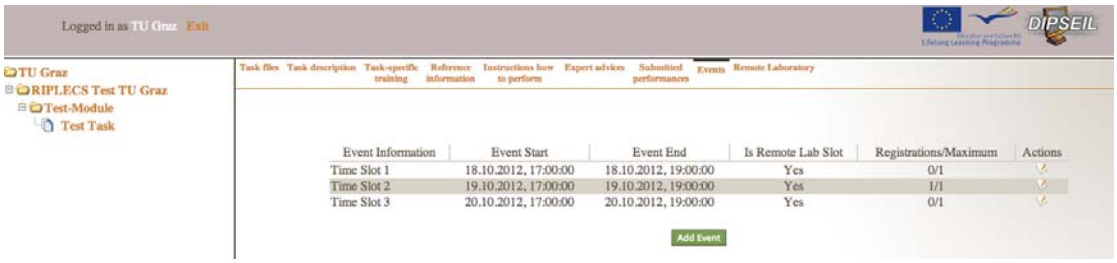
The RIPLECS project is based around the DIPSEIL system, which is a performance oriented learning management system and has a pool of practical tasks to perform. The first task in the project was to extend DIPSEIL with a new instrument – remote laboratory.



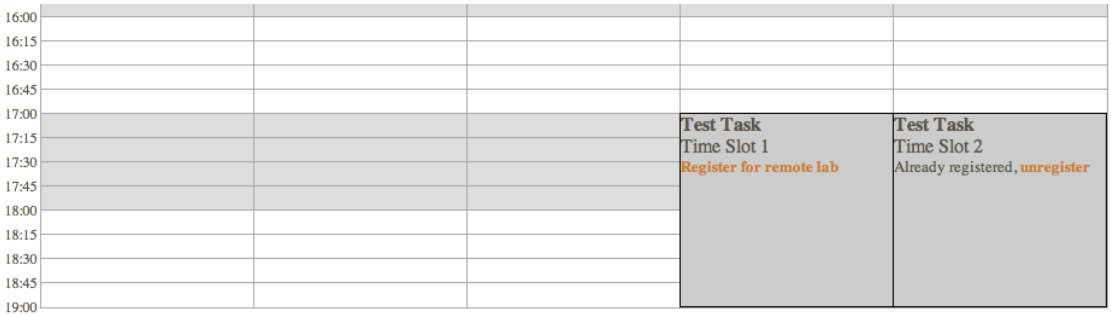
This instrument provides connection and control of authentication to the individual remote laboratories, found at the partners' locations.

To properly authenticate the students, the user database of the DIPSEIL system was used. An appropriate protocol had to be developed, which allows a cross-check between the remote lab interfaces and the user database. This protocol is based on TEA encryption for passing information securely between the different systems.

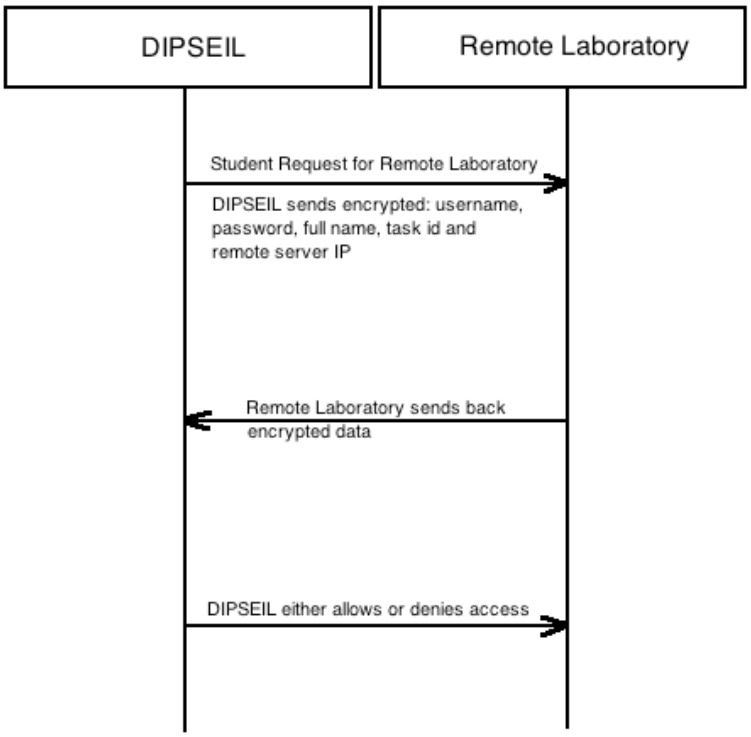
The DIPSEIL system was also extended with the so called time slots. Since laboratories are rarely used by more than one person, a way of control who uses which laboratory and when, had to be developed. Tutors have to specify time spans, at which the laboratory is available for remote access and how many persons may use it at a time.



The students may then register for a specific time slot to use the remote laboratory.



The authentication protocol then checks if the student accessing the remote laboratory has properly registered and then grants access if this is true. The remote laboratory interface receives from the DIPSEIL system information about the user and has to send it back to DIPSEIL for cross check. This way, a direct access to the remote lab is denied.



The protocol is already deployed at PU and TUG. It is in deployment at UNED. Due to the specifics of the remote laboratories at TUS and DEIS, they will not use it, but will provide the students with informative instructions how to start using their remote laboratories. These instructions will be integrated into DIPSEIL also. Students will have to follow them, so that they can use these two remote labs.

PU will provide a remote lab in telecommnunications. They already have a specialized kit, which can be controlled by software. PU will provide VNC access to this software. Moreover PU has developed a complex multiplex system, allowing the student to switch between

various antennas. This way, he/she can observe different telecommunication events with different antennas. Only one student is able to control the kit at a time. PU will offer a second connection, with observer rights only. This way students can work in groups from different connection points.

TUG will offer a laboratory in wireless sensor networks. They have developed a dedicated remote lab interface, which is able to perform control and measurement over different network situations. This interface is web based, so the student will need their browser only. Information is sent and viewed in real time. Again only a single control connection is allowed, so only one student may work with the laboratory at time slot.

UNED have a laboratory in electronics, which is also controlled via a web interface. It allows students to engineer various electronic schematics and to perform measurements in real time. Up to ten simultaneous connections can be opened to their system.

TUS will provide the powerful software tool Cadence as a remote laboratory. Students will be able to perform experiments on microelectronic level and will gain knowledge about microelectronics and chip development.

DEIS will offer remote laboratory for multimedia. They will create a number of virtual machines, which will be remotely accessible. On them, multimedia materials will be preloaded and the software needed to perform the tasks will be pre-installed. Materials prepared with the virtual machines by the students will be automatically transmitted as a solution in DIPSEIL.

Evaluation Plan and Strategy – on the Web page, Project results

Evaluation of the RIPLECS system
The purpose of this evaluation session is to identify issues with the system before starting using it in courses. The project partner institutions use different remote labs, but they will have a common interface and a functionality within the DIPSEIL platform. The success of the RIPLECS educational approach is contingent upon the usability of the RIPLECS system. Three approaches for testing usability of the system are planned.
Walk-through-the-system

The students will try out three realistic tasks with the RIPLECS system on a one-to-one basis with a session's moderator. While performing on each of the tasks, the participants will be observed and asked to share their experience with the system. Apart from individual interviews, the session includes also focus group interview with all the participants. The students will be asked a few questions to trigger their reflection on the experience they have got with the system.

The walk-through-the-system and interviews (individual and group), will be conducted in one session with 5 students at each site. Research indicates that 25 participants altogether would identify more than of 95% of the issue with any system (Turner**,** Lewis and Nielsen, 2006**.**).

For the walk-through-the-system and interviews a special script will be prepared to guide the moderators. (See the document about RIPLECS measurement instruments for more details)

Heat Maps

Heat maps provide visual representations of the actual or predictive behaviour of the users of a particular web site based on the number of clicks and places of clicks. This web analytics informs designers for issues that users encounter. Heat maps and their modifications are thought to be able to replace the very powerful but also very expensive eye tracking technology. An advantage of heat maps is that they can work online with many users.

Performance achievement of students

The purpose of this evaluation activity is to measure the effect of the RIPLECS approach on performance achievement and attitudes of students. Perhaps the best direct way to measure the effect of the RIPLECS approach on performance achievement of students is a pre-test, post-test, experimental and control group experimental design, which compares the performance of a group of students (experimental group) working under the RIPLECS and a group (control) using another approach (e.g. face-to-face lecture-exercise format). The students need to be randomly assigned to the two groups (or at least the groups randomly assigned to the experimental and control conditions) and the task to work must be the same. At least 15 students per a group need to be involved to draw meaningful conclusions.

Another option is repeated measures experimental design. It involves one group of students to perform first on one task using a traditional instructional method at a particular time and then at another time exercising a second task from the same task class and degree of difficulty applying the RIPLECS approach. For another pair of tasks, the order of the instructional approaches needs to be changed as it might be a confounding variable and a treat for the validity of this type of experimental design.

If options for direct comparison of groups are not available, some information can still be collected applying case study design. It is one group working with RIPLECS and the teacher gathers information through observations of learners' activities and their outcomes. The teacher must rely on his/her professional expertise referring to his/her teaching experience with the course (module, tasks) in the past.

Although the three experimental designs differ in the empirical evidence they produce, the main purpose of collecting information is to improve the RIPLECS approach.

Talks with students and teachers during separate focus groups sessions can also be a reach source of information for improving the approach. The moderators of the session will be provided with detailed instruction how to conduct interviews (e.g the structure of the interviews, main questions, possible prompts and how to avoid asking leading questions). The optimal size of a focus group is 5-10 people.

RIPLECS attitude questionnaire

A questionnaire will be prepared for getting straightforward information about attitudes of students towards the RIPLECS approach. The consortium had already got some expedience with such a questionnaire (Tawfik,, Sancristobal, Martín, et al, in press). The questionnaire might need some re-design as reformulating some of the items and adding new scales (e.g. effort expectancy, motivation, likelihood of adoption, and facilitating conditions). For more details see the document RIPLECS Measurement instruments),

Data Analysis

For the pre-test, post-test with experimental and control group experimental design, and repeated measures experimental design, descriptive and inferential statistics will be applied. The RIPLECS attitude questionnaire will need descriptive statistics. Individual and group interviews need to be recorded and transcribed. Grounded theory approach (Strauss and Corbin 1994) can be applied either to the audio or the interview transcripts. Grounded theory approach will be supported by Weft QDA, open source software for qualitative data analysis. In addition to the qualitative analysis, we will apply a quantitative approach to the text analysis (computational linguistic and latent semantic analysis) using the Leximancer software (Leximancer 3, 2010). The tool requires little pre-processing to analyses the text automatically. It shows the relative frequency of each concept, how often concepts co-occur within the text, the centrality of each concept, and thematic groups - the similarity in contexts in which the concepts occur (See Figure 1).

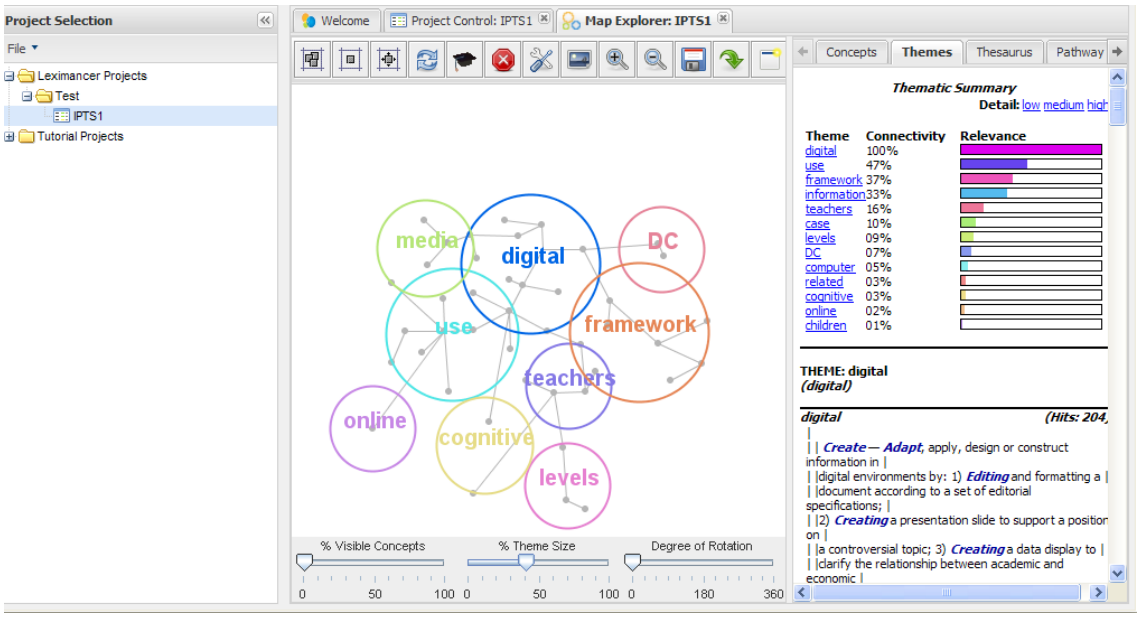


Figure. 1. An example of the main concepts in a text with Leximancer

Alternatively, if resources are not available for making interview transcripts, card sorting with heirarhical cluster analysis can add some quantification to the data. Instead of transcripts, the moderators can extract statements from the interviews and then 10 experts from the project consortium will be asked to sort the statements into groups on similarity in meaning using a web environment, caled WebSort (http://websort.net/). The environment allows the participants to easy sort the statements through simply 'drag & drop' them into groups (See Figure 2).

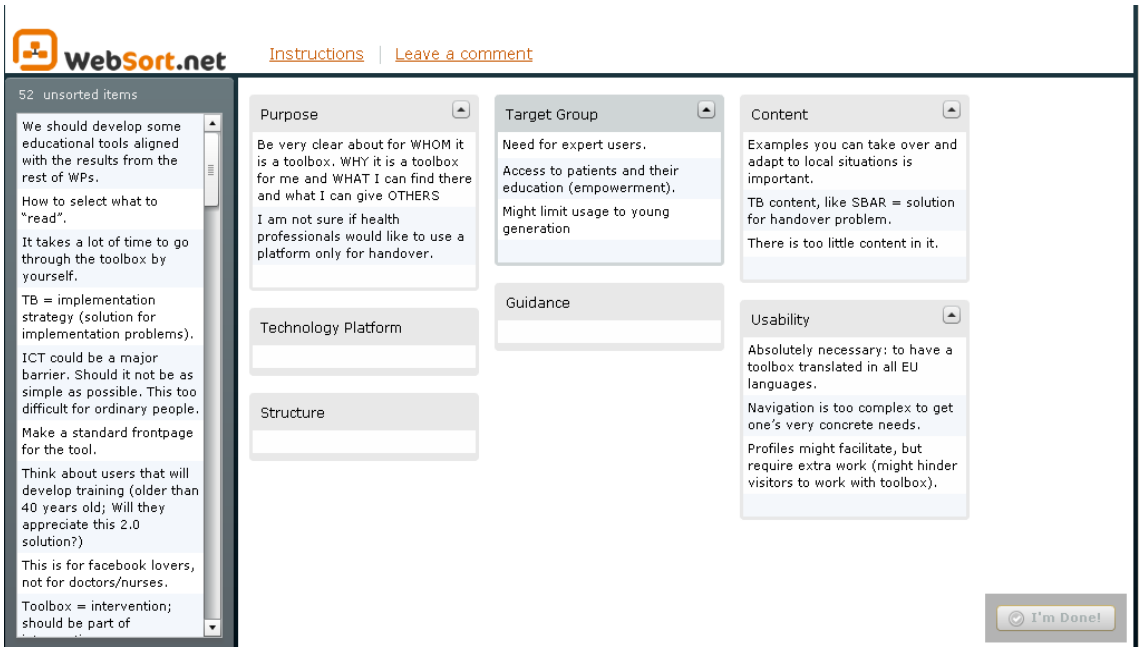


Figure 2. An example of drag & drop sorting

Websort provides four types of outcomes, namely: (a) a summary of the total number of categories including unique categories, participants' selection of categories and agreement between participants about their selection; (b) a visualisation of the hierarchical cluster

analysis as a three graph; (c) a category-by-item matrix and (d) and item-by-item matrix. Of them, hierarchical cluster analysis is the most informative technique (See Figure 3).

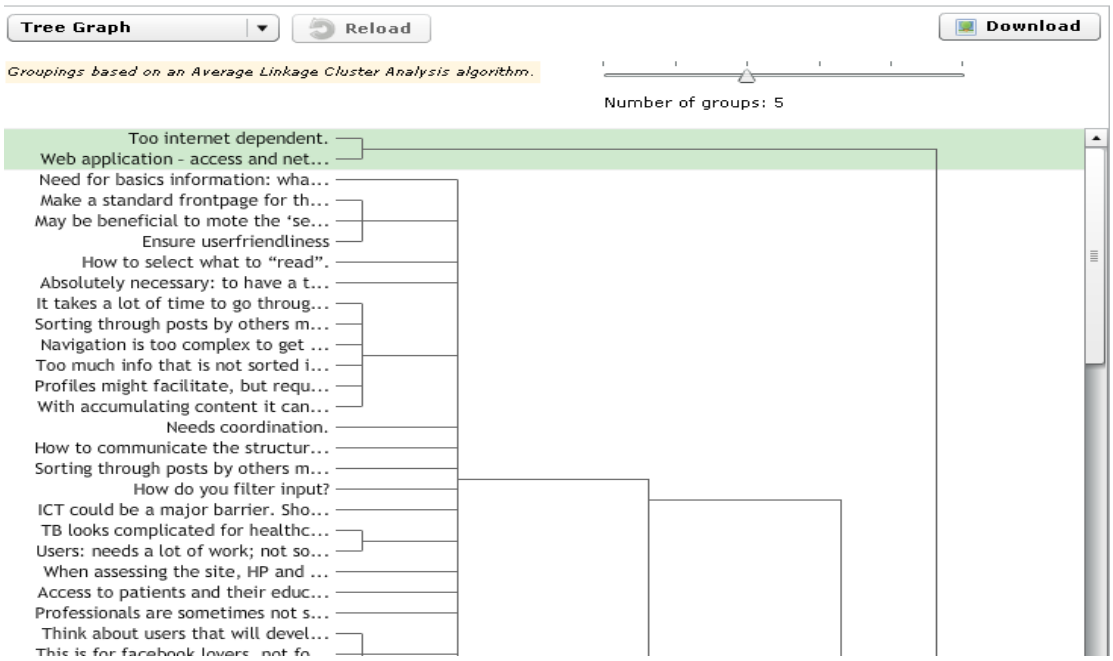


Figure 3. An example of hierarchical cluster analysis

Measurement Instruments – on the Web page, Project results

RIPLECS Evaluation script

The RIPLECS evaluation script is a detailed guide for the moderators to conduct walk-through-the-system and interviews sessions for evaluating the RIPLECS system. The script includes instructions for the participants, detailed information about each stage of the procedure, a statement of informed consent, and templates for collecting the information. A walk-through-the-system session typically has the following structure: briefing, test run, debriefing and wrap-up. Apart from what type of questions to ask at different stages, the script also advises on how to ask questions. Before the session the moderator needs to emphasize that the participants are testing the system, not the system is testing them. There is absolutely nothing that they can do wrong. The test of the system would not affect their learning achievements.

A simple metrics will be used to indicate how well the students deal with the tasks but they will not be made aware of that (e.g. 0% "Fails to complete the task correctly, gives up, or succeeds only with an assist from the moderator"; 50% "Succeeds, but in a roundabout way, making errors, needing to back track"; 100% "Succeeds quickly, following the route the designers intended"). These measurements are an indication how well the system functions not how good the students are.

Performance tests

The evaluation of students' achievement should be consistent with the underlying instructional approach of RIPLECS. It implies that the focus should be on measuring performance of the students rather than testing their declarative and procedural knowledge. Performance assessment requires a specification of the explicit scoring criteria when defining the range of performance level for a task, or a sample of work. It also suggests using verbal descriptors of the performance numeric scales. There are two scoring methods for performance assessment: analytical and holistic. In holistic scoring, a global score is given based on the overall impression of the performance. In analytical scoring, separate scores are assigned on different aspects of the performance.

The performance tests will be checked for validity and reliability. Construct validity means that we measure really the performance of students, not their knowledge of fact, principles or procedures. Content validity means that the performance test tasks represent all aspects of performance as given in its definition. Reliability is about the internal coherence of performance test tasks and their stability over the time.

RIPLECS Attitude Questionnaire

With construct and content validity in mind, the concept of RIPLECS approach has been operationalised through a number of more concrete concepts such as perceived usefulness, sense of reality/immersion, effort expectancy, motivation, likelihood of adoption, facilitating conditions and usability. These concepts determine the questionnaire's scales. In constructing these scales we consulted other similar instruments for acceptance of technology and usability (see Kirakowski and Corbett, 1993; Sauro and Lewis, 2009; Venkatesh, Morris, Davis and Davis, 2003) but adapted the items in these instruments to match the purpose of our project.

The 'Perceived usefulness/Performance expectancy' scale is about the extent to which the RIPLECS system improves learning. The scale 'Sense of Reality/Immersion' is about the degree to which the users feel the remote equipment is like real. The scale 'Effort expectancy' is about the system's efficiency, that is the extent to which it saves time and efforts. The scale 'Motivation' includes items, which indicate whether the system rises interests or elicits enjoyable experience. 'Likelihood of adoption' is about willingness to recommend the system to others and estimated interest of own and other universities to implement the RIPLECS. The scale 'Facilitating conditions' includes items about technical infrastructure, available knowledge and skills (both of students and teachers), and experience with using similar systems (teachers, students, and the university as a whole). 'Usability scale' is about the extent to each the RIPLECS system is easy to use, easy to learn how to use it, and easy to navigate.

In addition, the RIPLECS Attitude Questionnaire includes a question indicating how early or late people tend to adopt new educational technologies using the following categories: 'Innovators', 'Early adopters', 'Early Majority', 'Later Majority' and 'Laggards'. 'Innovators' are the first individuals to adopt new educational technology. 'Early adopters' is the second fastest category of individuals who adopt new educational technologies. Individuals in the category 'Early Majority' adopt new educational technologies after a varying degree of time. 'Later Majority' people adopt new educational technology after the average educational professional. 'Laggards' are the last to adopt new educational technologies.

The questionnaire applies a 1-to-5 Likert scale (1 = strongly disagree; 5 = strongly agree).

The questionnaire will be distributed online

European Master Degree Agreement – official document with information about courses, organization, credits and certification. (Web page, Project results)

MASTER IN INFORMATION AND COMMUNICATION SYSTEMS (ICS)

Curriculum Structure – 60 ECTS

1st SEMESTER: October-February

EVALUATION: February and September

COURSES: 5 compulsory courses (5 ECTS each one)

- Introduction to Information and Telecommunication Systems (PU)
- Industrial and Real-time Communications (UNED-DIEEC)
- Internet Technology (DEIS)
- Electronics for Information and Communication Technologies (TUS)
- ICTs research and engineering competence skills (UNED-DSCC)

2nd SEMESTER: February-June

EVALUATION: June and September

COURSES: 3 compulsory courses and 4 optional (5 ECTS each one)

- Microprocessor Techniques (PU & UNED-DIEEC)
- Wireless Communications (PU & UG)
- Multimedia (DEIS)
- *Two of elective:*
  - Power Supplies for ICT equipments (UNED-DIEEC)
  - Microelectronics (PU)
  - Satellite and Mobile Communications (PU & UNED-DIEEC)
  - Computer Modeling and Simulation of Electronic Circuits (PU & UNED-DIEEC)

FINAL MASTER THESIS: 10 ECTS

B A S I C F O R M

Title Identification Data	**Master Title**	Master in Information and Communication Systems
	Coordinating University	PU 'Paisii Hilendarski', Bulgaria
	Other institutions (With Agreement)	UNED, Spain
	Other institutions (only collaboration – not agreement)	DEIS – Cork Institute of Technology, Ireland TUS – Technical University of Sofia, Bulgaria UG – Technical University if Graz, Austria
	Type of education	**X** Attendance sessions/ practices/on-line X Distance
	Number of places offered	15
	Number of credits (between 60 and 120)	60
Title Justification	The Academic and Research Master on Information and Communication Systems is targeted to engineers, technicians and scientists with interest on up-to date topics in the area. This master-degree title gives a deeper and complete formation in the main research areas, as well as development activities linked to professional sectors.	
Study Plan – Objectives		

and goals	The main purpose of this master degree is to offer an advance and specific knowledge related to information and communication systems. Recent advances in electronics components and systems, advanced design, advanced communication electronic systems or application techniques in industrial sectors will be shown. Students will acquire skills focused on industrial field like production organization, design of products, processes and installations, quality management or multidisciplinary teams' management. Additionally different training and educational activities focused on research processes related to the electronics engineering field will be carried out.
Admission Profile	A graduated level in electronics (electrical and/or industrial engineering, applied physics, physic engineering, telecommunication, computer science or computer engineering) is needed to apply to the Master. There are no enforced prerequisites, however modules are master level programmes and have some expectation of prior student knowledge. The level of language recommended is high-intermediate English.
Academic Structure	**Teaching plan, modules or knowledge areas that constitute the Master's course** From an organizational point of view, the Master in Information and Communication Systems is developed in an academic year: two semesters plus the Final Master Project, which can be done in parallel with activities under the second module. This master degree is divided into 3 modules that are structured, at the same time in different subjects. The modules are composed of:

	• 1st Semester: FUNDAMENTALS MODULE: Deeper and complete scientific formation. ✓ 5 subjects (25 ECTS). • 2nd Semester: SPECIALIZED MODULE: Development activities formation linked to Academic, Professional and Research Sectors. ✓ 5 subjects (25 ECTS), 2 will be optional (2 subjects offered by each optional one). • FINAL MASTER PROJECT MODULE ✓ 10 ECTS
Teaching Staff	For the delivery of the program, the ECIT Department of PU has its own personnel, in addition to the support and cooperation of Spanish experts from DIEEC UNED, and several other European institutions as collaborators and teachers.
Resources for the study	Students can take courses remotely over the Web through the UNED's and/or DIPSEIL platform, using on-line and distance learning methodology, and performance-centered approach.
Implementation Timeline	Completed Basic Form: March 2012 Send to UNED's commissions: April 2012 General Agreement between UNED and Plovdiv University: April 2012 Description of subjects: July 2012

	Information for the Verifica Application: September 2012 Description of Summary Master Plan for ANECA: December 2012 Commencement of the classes: 2013/2014 Academic Year

4. Partnerships

The consortium unites universities teaching engineering and science, and open universities. It encompasses members from four countries with four different languages and from different application domains, including mathematics, physics, microelectronics, information technology and telecommunications. The partnership:

- Has experience in applying performance-centred approach in different educational and training contexts: regular university education, training and qualification, and community education;
- Collaborated successfully in the previous projects and in the development and use of the IPSS system in eLearning;

UNED-ED are experts in the evaluation of educational systems. They were responsible for the evaluation plan, experimental design, measurement instrument development and analysis of the results from the experiments. Together with PU they prepared European Master Degree Agreement document.

TUS, UNED, PU, DEIS are experts in e-learning environments and they were responsible for integration the remote access to real laboratories in DIPSEIL platform - organization and maintenance.

The concept of Internet accessible labs encourages cross-institution cooperation. We worked to realize a scenario: students at one university using a laboratory made accessible by a second university. Partnership organizations can share the cost of an expensive laboratory and physically establish it at a convenient location. Students have a possibility to have practical work in labs in different countries, which labs are usually very expensive (in some cases they are unavailable for public universities), and that offer practical experiments or technology with high quality, or limited access.

With the integration of telecommunication technologies and computer science with virtual instrumentation, real, remote laboratories were developed and accessed through Internet in real time, ensuring a richer collaborative experience for the student while avoiding some of the growing limitations of traditional laboratories, such as the lack of enough work area, expensive instrumentation, lack of personnel, time assigned to a laboratory, and their availability in non-working office hours.

Remote labs support distance education and provide student centred, cost efficient learning among the partnership. They give students the opportunity to collaborate over the internet with students in other three countries. While it would be most favourable to have students participate whether active or passive in live labs, the ability to record the labs allows participants to review labs and gives those with poorer internet connections or different learning or accessibility requirements the opportunity to access the lab in their own time, at their own pace.

With remote labs, there is an increased possibility to achieve an EU standard for certain courses or curricula. They reduce the pressure on resources in the participating institutes, for example, where lecturer numbers are lower, software is too expensive or timetables clash, students can be provided with access to these remote labs. Passive participants can still be active in terms of communication and collaboration with the lecturer and with other students.

The results of the project would be exploitable in many countries across Europe due to the translation in four languages. The representation of the consortium of engineering and science and open universities will provide for professional development and sharing of expertise across European traditional and distance universities from one side, and professional bodies from other.

5. Plans for the Future

Implementation of RIPLECS

Aim: Implementation of developed remote labs access in IPLECS in partners' educational contexts

Objective: Experimental study on the use of a new instrument 'Remoteness' in IPLECS environment through practical tasks performance

Tasks: We conduct two semesters' field trial with the developed courses. Each of the five universities – PU, TUS, UNED, DEIS and TUG, will put into practice courses developed from this university, in the original language, and realized remote lab access. The content of the learning materials, method of learning, the learning resources and learning platform with embedded 'remoteness' as a new instrument in IPSS with educational elements will be evaluated towards gained learning outcomes (knowledge, skills and competencies), students and teachers attitudes. After that the analysis of the results from the field trial will be performed with conclusions for the remote labs access implementation in ICS curriculum for a regular master degree program at traditional and distance universities. Some measures for the remoteness improvement will be undertaken before starting procedure and measures to develop European Master in ICS.

Time-table

First semester with 6 students from PU: we will start in November 2012 with the first two courses "Introduction to Information and Telecommunication Systems" and " Industrial and Real-time Communications". After that we will continue from February 2013 with "Internet for ICS" and " Electronics for ICS" (UNED Remote lab implementation). April – May 2013 will be "Wireless Communications" (PU and TUG Remote labs implementation) and "Satellite and Mobile Communications". June – July wil be "Microelectronics" (TUS Remote lab implementation) and "Multimedia for ICS" (CIT-DEIS Remote lab implementation).

Together with this first experiment, at TUG implementation of TUG Remote lab will be performed with 6 students from the university.

August – September 2013 we will analyse the data from the first circle of experiments and are going for improvement. We would like to perform a second circle of implementation at least four universities from the partnership from October 2013.

The official European Master Degree in "information and Communication Systems" will start from October 2013.

Preparing a Report from RIPLECS implementation

A scientific report with results from the data analysis and conclusions about the RIPLECS application and usability in reference to the European dimensions in higher education, particularly with regards to curricular development, interinstitutional co-operation, virtual mobility of students and academic staff, and integrated programmes of study, training and research.

RIPLECS evaluation

Aim: The purpose of the evaluation will be to serve decision making within the project but its main goal will be to help developers in the improvement of the product and development process. It will be more oriented to the end users, i.e. to obtain feedback to help developers to improve the products and services, to reveal unforeseen circumstances in the learning

environment, to insure better communication in the development team, to measure whether educational objectives are achieved and learners needs met.
Quality assurance (QA) is an integral part of the internal management of all partner institutions following the standards in the European Higher Education Area and the new courses will be objects of these QA procedures. Within the project we plan additional evaluation activities to guarantee both, the QA of education and of project management (see the table below).
The evaluation will be conducted during the whole project lifetime, starting with needs analysis, materials for practical laboratory work design and production, remote labs implementation, developers and tutors training, to the implementation stage - the pilot test. Learners will be involved in the evaluation process at the need analysis stage and then, when the first versions of prototypes will be ready. Interviews and questionnaires to gather data on learners' and teachers attitudes and opinions will be used.
The evaluation strategy triangulates different research methods (quantitative and qualitative), different types of experimental designs (pre-test, post-test with control group, and case study) different types of experimental subjects (students with different qualifications preferences, and teachers), different types of data analysis (descriptive and inferential statistics), across different content domains. Components of the evaluation strategy:

Phase	**Focus**	**Subjects**	**Methods**
Needs analysis of practical ICT education and translation into functional specifications of RIPLECS	User needs identification	Students; teachers, instructional designers, university management	Survey, interviews; experts' focus group; cognitive mapping
Development of RIPLECS	Usability; utility	Teachers; instructional designers	Walk-through; observations; interview; group discussion; survey
	Usability	Teachers; students	Survey
	Effectiveness (knowledge)	Students	Pilot
Development of a prototype of remote labs access	Effectiveness (skills, knowledge, competences)	Students	Pilot
	Effectiveness (attitudes)	Students; teachers	Survey
Implementation	Integration within the educational practice	Students; teachers	Action research; case study

Preparing Report from the evaluation of gained skills, knowledge and competences

Final Project Report presents our answers to:

- the need of practical ICT education and translation into functional specifications of Remote-labs access in Internet-based Performance-centered Learning Environment for Curriculum Support;
- whether the use of a new instrument 'Remoteness' in IPLECS environment for practical tasks performance is workable;
- the need of practically oriented/occupationally specific and designed for participants to acquire the practical skills and competences which usually provides the participants with a labour-market relevant qualification;

the need of support the realization of a European Higher Education Area, promotion a cooperation of universities and world of work, provision virtual mobility of students and teachers; support the development of innovative ICT-based content, services, pedagogies and practice for lifelong learning; provision open educational resources on-line and testing innovative performance-based e-learning.

Dissemination activities

Exploitation activities – European Master Degree program will start in October 2013

6. Contribution to EU policies

With remote labs, there is an increased possibility to achieve an EU standard for certain courses or curricula. They reduce the pressure on resources in the participating institutes, for example, where lecturer numbers are lower, software is too expensive or timetables clash, students can be provided with access to these remote labs. Passive participants can still be active in terms of communication and collaboration with the lecturer and with other students.

The results of the project would be exploitable in many countries across Europe due to the translation in four languages. The representation of the consortium of engineering and science and open universities will provide for professional development and sharing of expertise across European traditional and distance universities from one side, and professional bodies from other.

RIPLECS will continue with an open course initiative to build a case of good practice based on the collected experience in four European countries. The added value of the collaboration of partners from different European countries is:

1. In the larger impact of results and experiences of previous European projects.
2. In the new forms of co-operation between partner organisations: remote labs access as a tool in applying the performance-centred approach in a distributed curriculum.
3. Larger opportunities for dissemination and exploitation of project results

In general, the project will work towards providing open educational resources for virtual campuses by ensuring that organisational, technical and quality-related issues are addressed in order to share content, and make it easily accessible at European level and developments of the European Higher Education Area (EHEA) objectives for 2020 (Bologna process).