Open Learning Approach with Remote Experiments

Final Report

Public Part
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Executive Summary

In this report final results and achievements of OLAREX project are presented. The OLAREX is executed under the KA3 (ICT) activity in the Lifelong Learning Programme of the European Union.

The main goal of the project is offering to formal and non-formal education providers an efficient way to improve their e-didactic and digital competences. For this purpose a training programme with use of ICT-based learning materials, remote laboratories, and e-learning methods has been created.

The remote laboratories use Internet to remotely conduct real experiments on real equipment (http://www.olarex.eu/web/index.php/en/teacher-en/rem-lab-t-en). The advantages of such laboratories are unique. Equipment can be shared by students 7 days a week and 24 hours a day in every corner of world. The structure of remote experiments allows supporting autonomous student’s learning, independent individual work, demonstrations in class and, what is important, executing lab assignment safely.

The project primary target audience is representatives of formal STEM (Science, Technology, Engineering and Mathematics) education - European secondary schools: teachers, their students, and administrating and managing staff. Other target group is providers of non-formal education, mainly polytechnic, field and natural science museums.

The main output in the OLAREX project is the online training programme for secondary school teachers in six consortium countries: AT, BG, HU, LT, PL and ES. The training consists of five ICT training courses and six learning modules that were developed to provide didactical support in remote experiments for the introduction to remote laboratory training course. The subject of all education products - courses and modules - were chosen based on the reports “Current State and Competency Needs Analysis in Partners Countries” provided by all partners. In order to bring motivation and joy to learning, some parts of the learning materials and museum demonstrations had been prepared by school and university students.

In short as well in long term, the project outputs and products were and will be in future widely disseminated to target audience over website, conferences’ presentations, workshops, seminars, and museum exhibition (Sofia, Bulgaria). During the final roundtable (8 October 2013 Sofia, Bulgaria) the further developments of integration remote experiments in the secondary school curriculum, implementation of technology to enhance learning, methods of involving teachers, students, parents and other stakeholders were discussed.


All OLAREX products are validated by evaluation tools based on the SEEQUEL methodology.

For more information please visit the OLAREX website: http://www.olarex.eu.
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1. Project Objectives

Technologies play key roles in transforming classroom into flexible and open learning space. New IT devices and gadgets are making their way into schools, offering unlimited potential to educators. But the key question remains: how have these technologies improved learners’ experiences or learning performance? Schools, educators, universities, and policy makers - all look for intelligent solutions on how to modernize curriculum frameworks and assessment processes, as well as implementing contemporary technological tools.

The enhancement of STEM curricula with virtual and remote experiments by fostering students’ creativity and motivation and the development of professional e-didactic and technology competences and skills are the primary project aims. It responds to the Europe 2020 Flagship initiatives: the Digital Agenda for Europe, Youth on the Move, and An Agenda for New Skills and New Jobs and to the contemporary trend. According to in the next five years the use of Virtual and Remote Laboratories has a great potential to improve STEM teaching and learning in schools.

To accomplish the project aims, we reached the following objectives:

(1) created analysis report of the target group needs: the demand of ICT competence development for secondary school teachers as well as the existing and expected STEM knowledge and skills requirements to successful transition in higher education and vocational training for school students, and in career for university students. The recommendations for suitable education methods, usage of remote experiments, learning contents, and conceptual design were prepared (http://www.olarex.eu/web/index.php/en/products);

(2) settled multilingual e-learning portal to provide e-materials and learning tools with remote experiments (http://www.olarex.eu/moodle);

(3) established training programme (http://www.olarex.eu/web/images/olarex/CD/index.html) consists of five ICT training courses topics. The topics were chosen based on the results of analysis report (1). Training included online, face-to-face and blended activities;

(4) developed six learning modules with remote experiments, practical tasks, and interactive multimedia e-materials support training course - introductory to remote laboratory;

(5) opened exposition “Robots and Remote Experiments in our Life” in National Polytechnic Museum, Sofia, Bulgaria at 10 June 2013 during the national conference “The museums and sustainable development”. After the project the exhibition is available for the museum visitors in permanent and travel formats;

![Figure 1: Face-to-face trainings in Bulgaria, Lithuania, Spain](image-url)

(7) initiated school-enterprises linkage: in-house Open Door days have been organized for school senior students and their teachers by associated partners;

Therefore, OLAREX supports educators with key competences in education technology, offers tools for active learning - remote experimentation, and develops digital student competences by providing the interactive learning e-materials with remote experiments.

The developed education products will be accessible after project for target audience: teachers and students of secondary schools, national ministries of education, and education and training providers.
2. Project Approach

In order to achieve the aims and objectives mentioned in this report, different pedagogical and methodological approaches were considered. One of pedagogical approaches is building up-to-date e-didactic and technology competences for professionals who pedagogically support formal and non-formal learning. Another approach is providing the students with active learning instruments such as exploratory remote laboratories.

Two project WPs focus on the fulfilment of these approaches: development and implementation of the training programme including five training courses for the secondary school teachers (formal education) and museum employees (non-formal education) (WP5) and learning modules with remote experiments – didactic materials of a remote laboratory implementation in classroom. The learning modules are mostly oriented on the senior students of secondary schools (WP4). The WPs “Project coordination and management” and “Quality assurance and evaluation” ensure high quality level of all project outcomes and results. The WP “Quality assurance and evaluation” is split in internal and external evaluation. Chosen and approved by EC the SEEQUEL framework is used for the evaluation. Through the internal bimonthly reports and partners evaluation of deliverables and products, a regular quality control and reflection of all project stages are guaranteed. The project evaluation plan developed by Europa Media Ltd. implicates the quality rating of the OLAREX deliverables and products, and their impact.

To ensure the complementarity of the existing curriculum and the newly created learning materials the OLAREX partners cooperate with the staff of secondary schools. The concept of OLAREX products was established on the contemporary methods of the development of online learning courses taking into account specific national educational characteristics. The content is available on the project website.

Overall, the project methodology is in line with the OLAREX objectives. The consortium applies different techniques in order to achieve these objectives:

- e-surveys to find current state and needs;
- e-content with remote experiments;
- learning environment tailored to learning requirements of each user;
- video conferencing with desktop sharing and video recording for training purposes;
- museum exhibitions;
- usage of social networking and external free tools;
- WEB2.0/3.0 technologies.

To ensure the sustainability of the project results and outcomes the consortium developed a primary strategy. This strategy includes two stages: (1) transferring the deliverables to interested institutions and encouraging end-users to use project results; (2) the final plan will update the initial one with specifications how the deliverables could be exploited and commercialized: impact on educational sector; limitation of the deliverables and museum exhibition commercialization.

The main dissemination tools for OLAREX are the website (Fig.2), Facebook wall, EVE database platform, and Learning Resources Exchange metadata supported by EUN - European Schoolnet. There the project’s oncoming activities, products, experiments and results are published.
In addition, information on the project is disseminated via national and international conferences, seminars, workshops, journal papers, newsletters. Flyers and posters issued in all national consortium languages are presented on conferences and events. The book “IT Innovative Practices in Secondary Schools: Remote Experiments” and final roundtable in Sofia, Bulgaria consummated activities during the project. The guests from Ministry of Education and Ministry of Culture of partner countries participated into the discussion on the further modernization of education through technology in their countries as a special issue for Europe.
3. Project Outcomes & Results

The main output of OLAREX project is online training for secondary school teachers in six consortium countries: AT, BG, HU, LT, PL and ES. As a result OLAREX will create a pool of trained national representatives of secondary schools in STEM education. In order to perform successful training implementation the following main activities were executed: analysis of the existing situation in consortium countries, concept design of learning modules and training courses, implementation and deployment of a learning environment with remote laboratories, specification of learning modules and materials, and face-to-face workshops, seminars, meeting and discussions with secondary school teachers.

I. ANALYSIS OF EXISTING SITUATION

During the first project months the consortium created an e-survey for studying the existing situation in the partners’ countries. The e-survey was executed in eight EU languages: EN, BG, DE, HU, PL, LT, ES and euskera. Four different sets of e-survey for target groups were prepared and accomplished:

(1) Secondary school - seniors and last two years, and university - freshman undergraduate students;
(2) Secondary school teachers;
(3) Secondary school administrative and managing staff
(4) Managing staff of SME and large enterprises

Overall 1025 students, 319 secondary school teachers, 64 representatives of the secondary school administration such as directors, headmasters and leaders of the departments and 40 representatives of the managements of SMEs and large enterprises have participated in the e-survey.

The OLAREX reports “The current and estimate future knowledge and skills needs” and “Target group educational needs analysis” were compiled based on the partners’ analysis reports “Target audience analysis from online survey” describing state-of-the-art STEM education of the secondary school sector in their countries. Based on the reports’ conclusions the partners identified the methods, instruments and content approach to comply with expected ICT competence demands for the collaboration with the primary target groups: secondary school teachers, their students and museum employees.

II. TRAINING PRODUCTS

The results of their work are five training courses embraced in the ICT competence development training programme (Fig.3), and six learning modules supporting the course, addressing remote laboratories and experiments. Master and PhD students of the partners Universities had been participated in a development of the remote experiments and the learning content. The training courses are:

- Designing curriculum for Moodle virtual learning environment
- Empowering education: How to choose ICT instruments and applications for the purpose of your curriculum
- Using ICT for presentational and educational purposes in the museum
• Transforming curriculum with remote experiments: how to integrate it in secondary school classroom
• ICT – enhanced Research and Professional Development

Figure 3: Training Schema

Topics of the six learning modules with remote experiments were chosen by secondary school teachers and their management over the e-survey:
• Black body radiation of common light sources (Physics /Optics)
• Farm Experiment: From an egg to a baby chick, step by step (Biology)
• Working as a computer – Logic gates (Technology & Mathematics)
• Analogue circuits measurements (Physics)
• How does the current flow? (Physics)
• Easy Java Simulation for Physics & Sports

The content and remote experiments are accessible over the OLAREX website without any restrictions.

III. ONLINE TRAINING

The online training was organized in March-June 2013. More than 200 teachers including developers of learning materials, and 40 museum employees had a chance to get an additional knowledge and skills in ICT contemporary instruments and remote and virtual laboratory application. During the project participated secondary school teacher involved around 500 their students to the activity. The OLAREX website offers the access to the training.
V. LEARNING ENVIRONMENT

The Moodle – a widely used learning management system – is used as a basis for the OLAREX learning environment. It is the primary place, where training courses are uploaded and learning materials and modules are stored. The main tools of the application were tailored for the needs of the target groups. The plugin that integrates remote laboratories such as WebLab-Deusto, iLab, VISIR into Moodle will be deployed at 2014.

http://www.olarex.eu/moodle/ (password protected area)

VI. MUSEUM EXHIBITION

Museum exhibition "Robots and Remote Experiments in our Life" is developed using multimedia, remote experiments and interaction. The exhibition was opened on 10 June 2013 during the Bulgarian national museum conference, organized in National Polytechnic Museum (NPM) in Sofia, Bulgaria. The exhibition consists of roll-banners with main information presenting remote laboratories and robots in our life: education, industry, domestic usage; remote Robot Experiment (RoMIE) - manipulation of the robot in a labyrinth; robot game; exhibition of robot heroes on the European corner at the museum; animation, presenting for kids the remote experiment idea in clear visual way. Around 1000 museum visitors have played with experiment harmlessly developing curiosity and creativity. This completely new outreach of museum's entertainment is popular for kids and adults. After success in NPM the consortium decided to design a travel exhibition to introduce the remote laboratory and experiments to wider audience out of the capital of Bulgaria. We believe that this sustainable tool will pique the society interest in science, technology, and engineering.

VII. EVENTS/WORKSHOPS

The face-to-face workshops and seminars are effective instruments to impact on the target audience. 12 face-to-face trainings were organized during project in all partner countries. The main topic was remote laboratories and their implementation into classroom. Presentations are published on the project website (http://www.olarex.eu/web/index.php/en/teacher-en/workshops).

Moreover, OLAREX outcomes were presented at more than 15 international and national conferences such as EDEN 2013, REV 12&13, EDUCON 2013, iCERI 2012, ICL 12&13, FiE 2013, ECEL 2013, etc.

VIII. PUBLICATIONS

Publications are a crucial part of OLAREX's dissemination activities, as they conclude important discussions, outputs and results of the project. The consortium publications and public activities are available on the front-page, Publications and Printings of OLAREX website (http://www.olarex.eu/web/index.php/en/products/printingsnew) for all interested parties.

Beyond the numerous publications in journals and conference proceedings, the consortium designed the summary book "IT Innovative Practices in Secondary Schools: Remote Experiments". This book presents the topic of modernizing the school sector through IT and promoting a culture of experimentation and supporting students with interactive experimental laboratories. The remote laboratories may prevent the marginalization of practical skills in schools.
4. Partnerships

The project consortium consists of eight partners and four industrial associated partners from six European countries – Austria, Bulgaria, Hungary, Lithuania, Poland and Spain. The consortium structure (Fig.4) of educational institutions, provider of Adult education, museum and SME sector is an advantage of OLAREX team.

![Figure 4: The structure of the consortium](image)

The consortium has extensive European and international expertise. An important added value of the consortium is:

1. the national expertise represented by all forms of formal education – secondary school, university and lifelong learning adult training; and non-formal creative learning - museums;
2. strong influence on European activities through other European projects and professional networks;
3. exchange of experience and knowledge that each partner brings to the project;
4. dissemination and exploitation of the project results over roundtables, debates, workshops, seminars, conferences on local, national and European levels.

Definitely, partnership has a positive impact on the quality of project products. The consortium is designed in such way that all partners are actively involved in common tasks to reach the project goals. Therefore each product is the result of the European teamwork merging different education systems, different requirements, and work style. This variety is an origin of the quality of OLAREX products and results. Thanks to the partnership, the remote laboratories - contemporary engineering learning instruments - become available for the partners’ secondary schools. At the same time, the consortium countries learning strategy and working markets tendency impact on the appearance of project’s learning modules and training courses content. Two university-school pairs P1&P2 and P4&P5 allow the tuning of the project education content to the requirements of secondary school STEM curriculum.
Figure 5 shows the geographic presentation of the consortium.

Figure 5: Geography of the OLAREX consortium

Brief description of the partner roles:

- University of Deusto, Spain (P1) is responsible for project. It creates learning materials and remote experiments for school curriculum and museum exhibition; supports development of e-competence in the secondary school sector of Basque Country, Spain.
- P. Andres de Urdaneta secondary school, Spain (P2) contributes into development of modules for teaching, evaluation online training, and supports the realization of OLAREX projects at the school.
- Europa Media Ltd, Hungary (P3). Its duty is a quality assurance and evaluation of project products and management, a support of OLAREX realization in Hungary.
- Carinthia University of Applied Sciences, Austria (P4) is involved in the project as a learning modules developer and one training course based on remote experiments for formal and non-formal education activities, and as a supporter of the realization of OLAREX in Austria.
- BG/BRG Peraustraße, secondary school, Austria (P5) contributes into development of modules for teaching, evaluation online training, and supports the realization of OLAREX projects at the school.
- National Polytechnic Museum, Sofia, Bulgaria (P6) designs and supports dissemination activity in the project. The organization of an OLAREX exhibition and supporting the realization of OLAREX in Bulgaria are their main objectives.
- Innovative Studies Institute, Vytautas Magnus University, Lithuania (P7) brings its e-didactic knowledge and skills to the consortium, organizes online training, and supports the consortium in designing e-learning materials. It is also responsible for a realization of OLAREX in Lithuania.
- Higher School of Radom, Poland (P8). The main task consists of an organization of survey for project targets groups, writing analysis results and establishing the target groups
knowledge and educational needs based on the survey responders study; training course development and moderation; a support of OLAREX realization in Poland

Baratze Farm - Baratze Baserri Eskola, Barrio Basetxetas, Vizcaya became the associated partner of OLAREX consortium during the second year. This organization have consulted and supported the consortium for the practical part of the Biological Module – chicken incubation. Ingeniería de Microsistemas Programados S.L., (AP1), Cenker Robotics S.L., (AP2), Spain and me2c — [micro] electronic Cluster, Austria (AP3) have provided information about industry requirements for future employees and supported in an organization of in-house Open Doors for secondary school students.
5. Plans for the Future

OLAREX will continue to provide an online access to project materials and resources to support a usage of remote laboratories equipment in school sector. In order to open all spectrum of remote experiments benefits, the e-didactic competence of school teacher and their students should be available for broad audience. For this purposes the online training developed over the project and consisted of five courses is available for future use on OLAREX learning environment, website, and CD. The introductory course on the remote laboratories concept supported by six didactic learning modules including examples of remote labs adoption in the classroom context are offered to teachers over the training as well. The remote experiments created during project are feasible through the OLAREX website and Learning Resources Exchange metadata supported by EUN. The remote and virtual experiments will be provided for further dissemination over the other running, e.g. GoLab (FP7), and future European projects.

Other plans for the future include promotion the OLAREX summary book “IT Innovative Practices in Secondary Schools: Remote Experiments”. The book is a collection of articles of researchers well respected in the international professional community. To reduce the language barrier the book will be available in Bulgarian; as well as all learning products are offered in consortium national languages.

Some new activities are already schedules for forthcoming months: travel exhibition - posters, remotely manipulated robot, physically situated in NPM in Sofia, and remote labs available from the CUAS and UDeusto - is designed and prepared for displaying at Bulgarian schools and museums out of the Bulgarian capital. The travel exhibition is starting at the end of 2013. The permanent exhibition for creating essential practice to work with remote objects is available at NPM in Sofia, Bulgaria.

Taking in account that in the next several years the remote and virtual laboratories have definite and at fingertips potential to be applied for teaching and learning in schools the OLAREX consortium will disseminate the results and outcomes of the project by involving broad number of participants of EU community, educating and encouraging it.
6. Contribution to EU policies

In order to successfully compete in a global economy, Europe aims to be amongst the most highly skilled regions in the world. Recent study shows that the occupational structure of EU employment tends to shift towards knowledge- and skills-intensive jobs in the consortium countries.

In order to support this demand, the nowadays STEM education should be modernized through the technology – significant component of modern industry, manufacturing, and services. The project contributes to the Europe 2020 Strategy (An Agenda for New Skills and New Jobs, and Digital Agenda) by the following tasks:

1. improving the e-competences of teachers and museum employees in STEM; for this purpose the training and didactic materials that incorporate the remote and virtual experiments – new trend of secondary school and university education methods, are offered;
2. involving school teaching staff in international and regional collaboration;
3. offering training and didactic materials along remote and virtual experiments – contemporary tendency in secondary school and university education methods;
4. initiating the school-enterprises linkage.

Therefore the main added European value and our main goal are concurred: offering to providers of formal (STEM teachers and educators) and non-formal (museum employees) education efficient way to improve their e-didactic and digital competences, which increase their work effectiveness.

Specific European added value of the project is:

1. improving the e-competences in the STEM by offering practice-oriented design for strengthening educational programs, and training with remote lab work explanations and technical practices;
2. modernizing STEM curricula by introducing remote and virtual laboratories;
3. the education content with remote labs is universally applicable and adjustable in STEM curricula of the EU secondary school sector;
4. increasing inquiry-based learning opportunities and rising students interested in STEM through the remote experimentations;
5. stretching interactive e-materials with remote experiments in the museum activities will open unique utilization of remote experiments in informal learning;
6. developing digital competences of students by multilingual access to interactive e-materials and remote experiments. Additionally, it can improve their transversal skills in English and six European languages (DE, ES, HU, LT, BG, PL);
7. international cooperation, complementation and exchange of knowledge, experiences and best practices;
8. positive experience of participants increases the interest in consuming other e-learning contents and contributing to extending the lifelong learning paradigm.