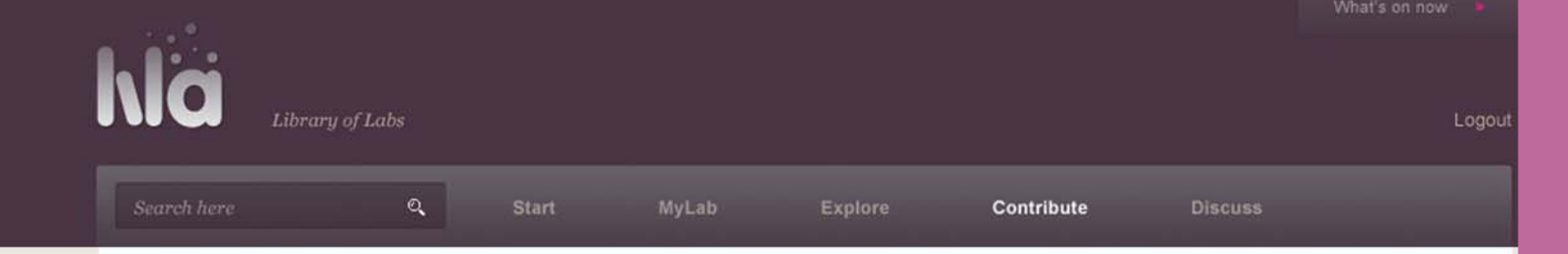


Labs online

Dr David Boehringer explains the work, successes and expectations of the Library of Labs as the EU-funded project continues its work connecting universities and science enterprises across Europe

Can you begin by outlining the overall purpose and objectives of the Library of Labs (LiLa) project?

The purpose of LiLa is to develop a sustainable infrastructure for sharing computerised 'virtual laboratories' and fully automated 'remote experiments' across the Internet. Specifically, LiLa will provide a searchable experiment database, communication tools, educational media, evaluation tools, access controls, a booking system, easy integration into learning management systems, entries for experiments in library catalogues, and connection to the 'Wonderland' 3D virtual environment. LiLa wants to help university teaching staff and students on engineering and physical sciences courses all around the world, and has recently joined the 'Global Online Laboratory Consortium' (GOLC).

Could you elaborate on the members of the LiLa consortium and the importance of their contribution and collaboration to the initiative?

Despite its name, LiLa is more than just a library and a large multinational team is needed to make it work, not just at a technical level, but also at a cultural level. The basic functionalities of a library are all there; you can of course browse the experiments, for which team members at University of Stuttgart, TU Berlin and CMCL have designed the necessary metadata standards. You can also sign into an experiment using our booking and user authentication facilities, which were developed by computing specialists at the University Politécnica de Madrid.

LiLa goes beyond being a mere library by providing teacher and learner support facilities, which were developed by TU Delft through consultation with the diverse membership of the LiLa consortium. Many other useful tools are also available. For example, staff at Sun Deutschland (now Oracle) has been helping us to place online experiments in the 3D Virtual environment 'Wonderland'. Users can also design virtual laboratories using the Modellica language, thanks to Linköping University and Mathcore Engineering. In fact, most of the consortium members contribute content to LiLa, including the Cambridge 'Reactor Weblabs', TU Berlin's 'RemoteFarm', CMCL's SRM websuite, Stuttgart's VideoEasel, Basel's 'NanoWorld' and AU Thessaloniki's 'LTFN' nanolabs.

For a project like LiLa to succeed it's vital to not just to tell people about it, but also to develop a self-sustaining structure, and both of these efforts have been led by strategists at Cambridge University and CMCL, culminating in the first LiLa Conference in April 2011. It's also important to get feedback, and AU Thessaloniki and TU Delft have been developing evaluation strategies and questionnaires which will soon be implemented in the portal. The project as a whole is coordinated by a team at Stuttgart.

Who will experience the greatest benefits from Lila? Will academic and enterprise staff profit to the same extent as students?

The strategy for LiLa is to make sure every stakeholder benefits. Students will have more opportunities for experimentation and a forum for discussing experiments with other students across Europe. They will usually have the flexibility to work at their own pace, at convenient times, and to repeat experiments. Educators will have better access to labs and educational materials for their students and can also search for labs to use themselves eg. for a live demonstration in an upcoming lecture, without needing to assemble the experiment beforehand. By sharing an online lab, a teacher can get feedback on an experiment, assistance in developing it further and the possibility of attracting funding, usage payments or reciprocal usage agreements. LiLa also makes management of online labs much easier and more efficient for staff through features such as the booking and access control services provided by the portal. This gives greater control to staff managing online labs, without the need to develop these mechanisms themselves for tasks such as scheduling access, routine maintenance, etc. Private enterprise can benefit from LiLa by using it as a forum for showcasing their products in an educational context.

How do you see LiLa developing in the future? Will you be looking to add further partners to the initiative in order to expand the network?

Facilitating sharing of online labs in Europe is the main objective of LiLa, so we are always looking to expand and include as many institutions as possible. We want to develop LiLa into a thriving community, which will help to fulfil its goals and allow it to serve as more than just technical infrastructure. We anticipate that as the user base reaches critical mass, this sort of organic growth will drive the development of LiLa.

Making the virtual a reality

The major research institutes of the EU are becoming better connected thanks to **LiLa** – an innovative portal for virtual laboratories and remote experiments aimed at aiding education for students and educators, whilst improving effective resource management for institutions

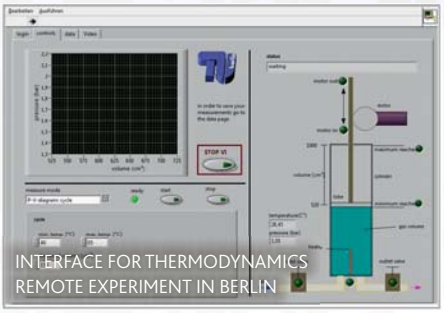
VIRTUAL LABORATORIES AND remote experiments are becoming commonplace in universities. However, no single university has the capacity to develop all of the tools they need. The Library of Labs (LiLa) initiative wants to provide a self-sustaining European infrastructure for universities and private enterprises that enables institutions to share and access the facilities they need online. LiLa's main audience is university teaching staff and students in engineering and physical sciences and it is hoped the project will bring many benefits to individuals across Europe.

There is great demand for a project like LiLa. For example, one of LiLa's members, TU Berlin, has more than 500 students participating in one undergraduate physics course. With their remote experiments, they can extend the students' insight and understanding of fundamental physics, beyond existing laboratory capacity. LiLa offers an online portal and community to connect such programmes. The Project Coordinator of LiLa, Dr David Boehringer, based at The Computer Centre of the University of Stuttgart, is keen to point out that, while the portal offers technical development in what was once a time consuming task of retrieving and scheduling virtual labs and remote experiments, its strength will always be based on what its members bring to the system: "The LiLa project involves major technical developments, but also demands collaboration with experts from many fields in order to meet all the requirements for a successful teaching and learning platform for online labs". LiLa is made up of 11 partners, eight universities and three private enterprises from seven European countries. It is the first initiative of this kind to have been developed specifically for Europe and is one of the largest integration and dissemination projects for online laboratories worldwide.

CONNECTING

Remote experiments are physical setups controlled and observed over the Internet, whereas virtual laboratories are frameworks for simulations that are solely run on computers. The overall objective is to provide students with the chance to make remote use of these facilities like the nanoscience Labs in Basel and Thessaloniki, which they wouldn't usually have access to. As Dr Markus Kraft from the University of Cambridge outlines: "Students will gain more opportunities for experimentation, increasing their understanding and gaining marketable skills, and will have a forum for discussing experiments with other students across Europe

SCREENSHOT OF THE LILA PORTAL HOME PAGE



INTERFACE FOR THERMODYNAMICS REMOTE EXPERIMENT IN BERLIN

and seeking support". Equally, educators will benefit from resources, such as demonstrations and experiments, without the need to develop these from the ground up. LiLa's key objectives are to create a repository of laboratories on a central server; integrate experiments into a central framework; implement a booking system; and provide the technical framework for the learning management systems of the participating universities. This system is expected to be particularly beneficial for countries and institutions with smaller financial capacities.

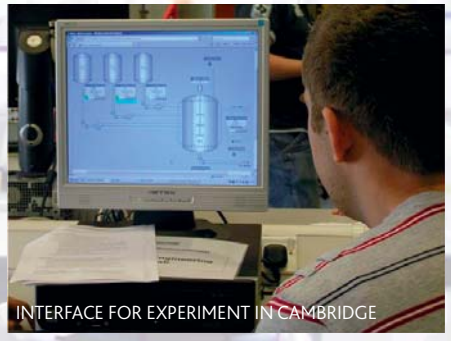
GROUP LEARNING

To make LiLa work, project partners are split into three groups: content providers, technology providers and scientific advisors. Experiments, laboratories, media and course content are provided by the first group, while the framework for sharing content is contributed by the technology providers. Scientific providers develop what might not be covered by the other two groups. For example, The University of Delft provides expertise in adaptive online courses and evaluating the didactical success of the project and ensuring students stand to gain from the LiLa project. Across the LiLa portal there are already remote experiments that are a fundamental part of the learning experience. For example, the Cambridge labs use industrial hardware provided by Siemens to control a bench-scale chemical process, so that students get hands-on experience with a state-of-the-art industrial control systems used in chemical and process industry. This can be accessed by almost any PC with an Internet connection.

Essential to these experiments and labs is how they are accessed. This has to be as straightforward as possible to ensure ease of use, as Boehringer explains: "The usability designers have done a lot of work to ensure that the portal is helpful and intuitive". Labs can be downloaded into their local learning management system as a SCORM package (Sharable Content Object Reference Model) or accessed directly through the portal. An essential feature of the portal, and the project in total, is the format in which experiments are hosted: "We decided to use the SCORM format for our experiments," states Dr Thomas Richter, responsible for the technical design of the portal, "because most universities we are aware of already deploy a SCORM compliant learning management system. Downloading and using an experiment for a lecture should be as easy as possible for our users." If a lab is required, a teacher can book it with students able to log in easily through their university registration and their learning management system with no need for any additional registration. Providing and uploading an experiment is similarly simple; additional infrastructure, such as a database for maintaining the booking of the hardware, can be automatically provided by the LiLa portal for those universities that eschew the overhead, but still want to contribute. Besides the technological advantages of the portal, it is the community aspects of LiLa that makes it stand out, with the possibilities it offers for enabling extended learning and a more collaborative, interactive approach. Developing remote and virtual labs is a technical challenge, while developing assignments and experiments that are useful for students is a pedagogical challenge. LiLa has pedagogical and technical specialists working to ensure that both of these needs are met. LiLa also offers possibilities to exchange assignments and other educational material as well as allowing students to contribute comments and material and to start discussions.

BRIGHT RESPONSE

One of the greatest challenges faced by the LiLa team is the wide range of ways in which remote



INTERFACE FOR EXPERIMENT IN CAMBRIDGE

experiments can be implemented and accessed. They have kept their approach flexible, but Boehringer believes that the problem will not be an issue in the future as members begin to create content with LiLa in mind: "This problem will lessen with time because developers of new labs will be able to consult with the LiLa consortium and consider compatibility with LiLa during the development process," he explains. Student response has been good with almost 90 per cent not only being interested in online experiments, but stating that online exercises improved their motivation. This suggests a bright future for the innovative content of LiLa, proving it to be desirable to its target audience.

Although LiLa started off as an EU initiative, the team is planning to operate at a global level and is part of the Global Online Laboratory Consortium (GOLC): "We successfully bridged software from the LabShare project in Australia, and we also have a prototype integrating the iLabs project of the MIT in Cambridge, MA," explains Richter. Future demands on LiLa will of course come from the community it serves but there are a number of areas the team is interested in developing further, such as the tutoring support and lesson creation tools. In continuing this flexible and innovative approach, students and teachers will all gain through LiLa.

INTELLIGENCE

LILA

RESEARCH AND LIVING LABORATORIES

OBJECTIVES

The project aims at the integration and dissemination of virtual laboratories and remote experiments at European universities.

PARTNERS

Universität Stuttgart (Computing Centre and University Library), Germany
Technische Universität Berlin, Germany
ORACLE Deutschland B.V. & Co. KG, Germany
Technische Universiteit Delft, Netherlands
Linköpings Universitet, Sweden
Universität Basel, Switzerland
Universidad Politécnica de Madrid, Spain
Aristoteleio Panepistimo Thessalonikis, Greece
University of Cambridge, UK
Computational Modelling Cambridge Ltd, UK
MathCore Engineering AB, Sweden

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DR DAVID BOEHRINGER is head of the Computer Centre's Department of New Media in Research and Teaching at the University of Stuttgart. Since 2002, Boehringer has coached more than 200 small media projects of lecturers which aim for curriculum-embedded eLearning settings. Boehringer's greatest interest currently lies in the development of middle-ware for eScience and eLearning applications.