

Virtual labs in Leonardo da Vinci "CELGAS" e-learning project

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Virtuálne laboratórium pre e-learningový projekt Leonardo da Vinci "CELGAS"

This paper discusses the problem of virtual lab capabilities in the e-learning. Using combination of web conferencing and "virtual labs" capabilities, a new quality distance learning teaching is now in preparation and will be included in the course teaching to produce interactive, online simulations for the natural gas engineering studies. The activities are designed to enhance the existing curriculum and to include online assessments. A special care is devoted to the security problem between a server and a client computer. Several examples of the virtual labs related to the PVT thermodynamics, fluid flow, the natural gas well-testing, and the gas network flow are prepared and tested. A major challenge for the 'CELGAS' system is in managing the delicate balance between the student collaboration and the isolation. Students may be encouraged to collaborate and work with each other, simulating their exploration of the lab material.

Key words: *Leonardo da Vinci, blended e-learned project, gas engineering, post-graduate study, virtual lab*

Introduction

The main objective of the Leonardo da Vinci Project 'CELGAS' (www.celgas.net) is to enhance the co-operation between the EU and East-European universities, research companies and vocational communities in the area of vocational education in the Natural Gas Engineering [1]. The partners which realize the project are: the AGH University of Science and Technology in Cracow, the Central Mining Institute in Katowice, SITPNIg (all from Poland), the TU Bergakademie Freiberg, DBI Freiberg, DWGV (all from Germany), the University in Sibiu (Romania), the Technical University in Kosice (Slovakia). The promoter of initiative is AGH University of Science and Technology - Drilling and Oil-Gas Faculty. The project will enhance a related knowledge by fostering the innovation in training through the transfer of state of the art research knowledge to local and regional companies. One idea can also be to attract companies that are involved in activities complementary to the gas area (gas equipment producers, safety equipment producers), companies or organizations involved in ecological activities. This international co-operation will develop a vocational training methodology in the field of natural gas based on the Management quality approach that will be based on the need assessment and the regional training customization. The partners involved in the project assume training with the following innovations:

1. International networking in the education
2. Continuing education (postgraduate e-learning study)
3. High quality of learning (internal & external validation)
4. Comprehensive approach to the accreditation
5. Active implementation of the content
6. Continuing revision of the postgraduate study content
7. Classic and innovative techniques in the education
8. Integration of the vocational community

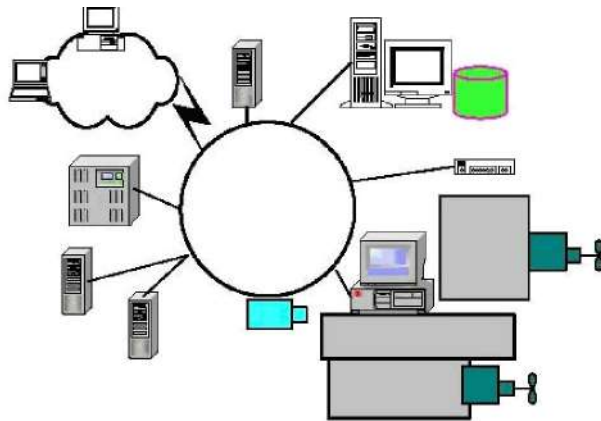
The accreditation of the postgraduate study will guarantee a quality of learning and their continuous modification, according to new techniques and technologies in the gas domain in the EU. A participation of engineers from various countries may be occasional giving opportunities for studies under this initiative. The accreditation of the 'CELGAS' training system at the partnership universities will secure the quality of learning. All Partners confirm their willingness to build-up the vocational centre with a possibility of a long-distance learning, exchange of international experience, use of internet gas engineering vocational forum, etc.

Why include virtual laboratories?

The 'CELGAS' idea is focused on the learner giving him a potential to have a higher quality of learning and an increased level of interactivity. This is executed by various forms of teaching. A *virtual laboratory*

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is one of preferred forms of the e-teaching in the „CELGAS' system. The virtual laboratories have the following features:



1. create situations where the learner can practice skills in a controlled and safe environment
2. unlike online demonstrations, the virtual laboratories ask learners to interact in some way with the task by inserting an information, making decisions and executing steps, providing opportunities for learners to revisit tasks.

Fig. 1. Example of a virtual labs system.

Integrating virtual laboratories in the e-learning system

The Virtual laboratories (Fig. 1) will be available on the „CELGAS' web this year. They will focus on: the PVT thermodynamics, the fluid flow, the natural gas well-testing, and the gas network flow they are prepared and tested to:

- Clearly define the steps in a process using a story-boarding process.
- Design the visual look and feel of the interactive.
- Decide on what happens if the learner gives an incorrect input.
- Decide on the feedback to the learner.
- Integrate the virtual demonstration into a complete learning design.

The observation of learners undertaking a virtual exercise may form a part of the formative assessment. It is likely that within the 'CELGAS' system the final assessment will involve applying the skills learnt in the virtual laboratory to real life tasks. Using the virtual laboratories engage learners in developing technology skills (Fig. 2, 3) [2].

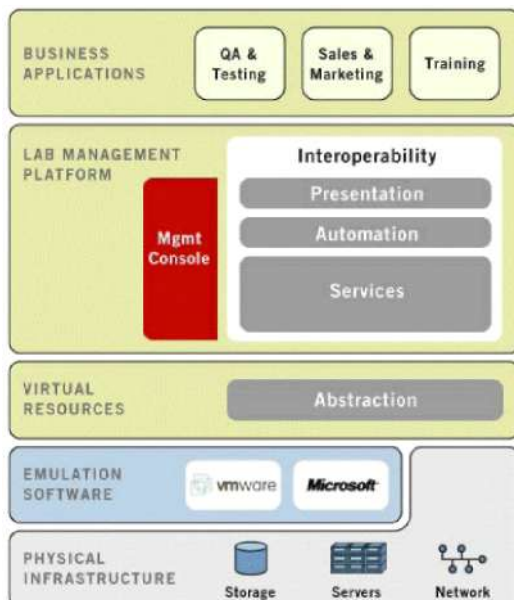


Fig. 2. Components of the virtual lab [2].

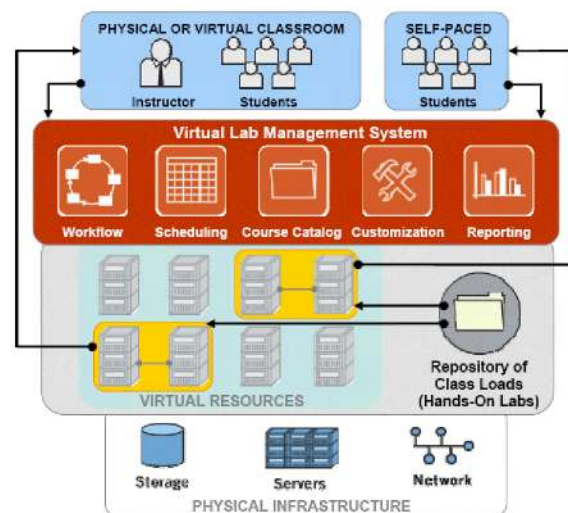


Fig. 3. Key elements of the virtual labs ecosystem [2]

Often, online virtual laboratory exercises will require the end user to have plug-ins (Flash, Shockwave, audio and video) installed on their computers. Increasingly, these plug ins are standard on computer systems

but you need to make sure that your learners can download any software that is required to make the exercise run.

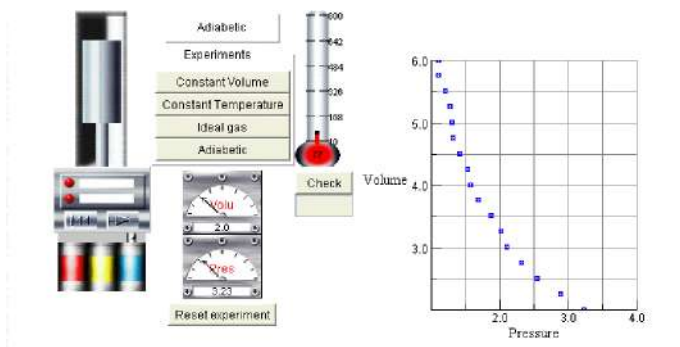


Fig. 4. Example of the thermodynamic virtual laboratory[3].

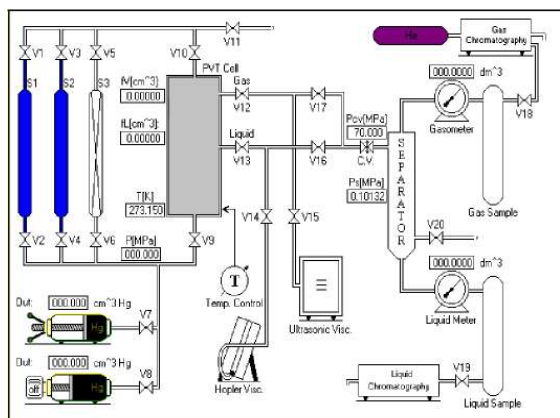


Fig. 5. System's PVT numerical simulator screen snapshot (simulations window after initialization).

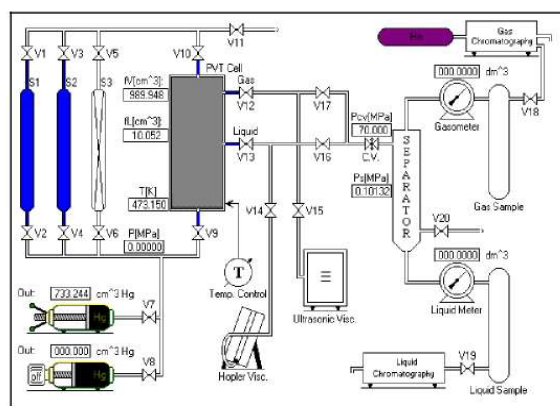


Fig. 6. System's PVT numerical simulator screen snapshot (simulations window after recombination).

PVT virtual lab

The application enables simulations of processes in the PVT system such as the system valves opening and closing, starting a volumetric Hg pump, performing a chromatography and viscosity measurements [4]. This simulations are performed, with the use of adequate numerical procedures [5, 6] which govern quantitative and qualitative changes in the PVT system, results from the interactive co-operation with an user [8, 9]. The results of the simulations and the user's interference are simultaneously presented on the screen and may be simple transformed to any other application. The simulations of the PVT system are performed in the application in the simulation window. A scheme presented on the screen (after defining the composition of the study sample and opening the simulation window) contain symbolically presented elements of the real PVT system (Fig. 5).

Each of the simulation window elements is an interactive object acting with the user - system operator. Activating of an element function (valve opening/closing, starting volumetric pump, PVT cell's bath temperature setting, changing separation conditions, etc.) is done through a mouse clicking or a menu option. Fig. 5 presents an example of the system's PVT simulation window, initialized for the gas-condensate measurements. The sample chamber No.1 (S1) contains a condensate sample, the chamber No.2 (S2) contains a gas sample. Fig. 6 presents the simulation window after a sample recombination (first stage of sample investigations in the PVT laboratory).

The sample recombination was realized through transferring gas from the sample chamber 2 to the PVT cell, the injection condensate to the PVT cell and the temperature set in the PVT cell's bath equal to the reservoir temperature 473,15 K.

The numerical simulator is an application co-operating with the user with a standard menu system. During each session with the simulator, the user works with files containing an information about parameters of the investigated sample components (critical parameters, molecular weights, acentric factors, binary interaction coefficients [7] and composition of investigated samples, located in the sample chambers and the PVT cell. Each of the above files can have a text comment.

The application has a standard toolkit for files with a simple administration. The designed program can solve flash and phase-equilibria calculations for user defined compositions, for any set of values of critical and binary interaction coefficients, and can create appropriate graphs of an equilibrium ratio

$K_i=f(P)T=const.$ Using the Schmidt-Wenzel Equation of State [11]. The user can set environmental application parameters such as the zero tolerance, the maximum iterations number, and the units system.

Conclusions

1. The Pilot Project allow to transfer the knowledge from the university and research labs level, using a blended e-learning method, to the specific regional company level (extraction, distribution, and safety). The participation of engineers from various countries may be occasional giving opportunities for studies under this initiative. The accreditation of the 'CELGAS' at the partnership universities will secure the quality of learning.
2. Inclusion of *virtual laboratories* into the educational system will achieve a better 'immersion' of student in actually presented practical problems [2]. The virtual Labs in 'CELGAS' will focus on the PVT thermodynamics, the fluid flow, the natural gas well-testing, and the gas network flow.

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