Virtual Technologies with WEB Solutions in e-Learning

Lubomír SMUTNÝ, Radim FARANA & Pavel SMUTNÝ
VŠB -Technical University of Ostrava, Department of Control Systems & Instrumentation,
av. 17.listopadu 15, CZ-708 33 Ostrava-Poruba, Czech Republic.
lubomir.smutny@vsb.cz , radim.farana@vsb.cz, pavel.smutny@vsb.cz

KEYWORDS: *e-learning, portal, Web support, e-Automation, virtual technology*

ABSTRACT: *Paper deals with the convergence of the Internet and education, which create Internet-enabled learning. New challenge "e-Learning" eliminates barriers of time, distance, and socioeconomic status, allowing people to take charge of their own lifelong learning. While a large set of e-Learning tools have already reached a quite mature level of usability, their integration within curricula is mostly in an exploratory stage handled by pioneer educators and multidisciplinary research group. The key questions include how to cope with the new tools that appear every days and how to concurrently renew adequately the courses pedagogical scenarios as well as the study programs. Renewals include approaches to sustain active and collaborative learning, schemes to hide technology behind the learning features, solutions to provide flexible learning modalities that combined on-campus and remote activities, as well as institutional incentives to promote e-Learning deployment. Virtual technologies connected with these new trends will cover topics as the shared collaborative learning environment architectures, WEB portals for actual hot links to the main information sources including links to the intranet/internet virtual laboratories, mobile learning systems ("m-Learning") dealing with mobile users, wireless systems, mobile devices and location awareness etc.*

New specialized portal "e-Automation" (see http://e-automatizace.vsb.cz) will be shown as an example of virtual technologies with WEB solution for e-Learning purposes.

1 INTRODUCTION

With the accelerated development of information technologies, there is an increasingly wide range of ways of reaching students who are geographically dispersed, of remotely accessing real laboratory equipment, of displaying and visualizing personalized distributed user interfaces and of running real time simulations over computer networks.

Emerging technologies are leading to the development of many new opportunities to guide and enhance learning that were unimaginable even a few years ago. There are already about one million courses on the internet, 30,000 of them compiling with a scientific definition of online, 22,000 of these are listed on the telecampus portal, with many of them making didactic use of the World Wide Web (Anonymous 1998). The e-learning includes online learning, web-based training, virtual universities and classrooms, digital collaboration and technology assisted distance learning. The WebCT kernel alone was used by 5 million students in more than an hundred thousands courses, developed by 40,000 university and college faculty at over 1,000 institutions in 50 countries. The acceptance of e-Learning or web-based learning is due to growing availability of commercially available Learning Management Systems (LMSs) such as WebCT, BlackBoard, Learning Space, IntraLearn , Top Class, eCollege, Click2learn, Authorware, LearnLinc ,Virtual-U, Web Course in a Box, UniLearn and WebBoard [SHARMA & KITCHENS, 2004].

The convergence of the Internet and education create Internet-enabled learning. New challenge "e-Learning" eliminates barriers of time, distance, and socioeconomic status, allowing people to take charge of their own lifelong learning.

Virtual technologies connected with these new trends will cover research challenges in the following areas:

- Instrumentation and control systems,
- Shared collaborative learning environment architectures and their components,
- Communication protocols, software, middleware, hardware, drivers,
- Application Programming Interface (API) and devices used to access distributed laboratory environments and equipment,
- Management policy,
- Mobile and location awareness systems,
- Heterogeneous wireless, satellite, terrestrial networks that make it possible to connect various geographically distributed devices and human actors.

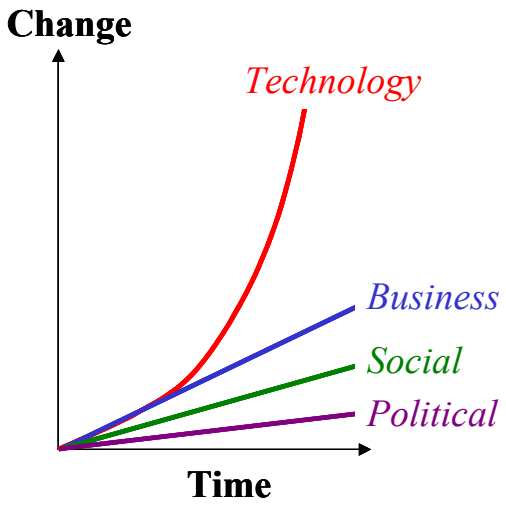

Figure 1. Law of disruption

Distributed online laboratories using virtual technologies with WEB solution have very other opportunities:

1. Current and future directions in the development of virtual and remote laboratories and the use in education.
2. Educational aspects of cooperative work in online labs.
3. Remote engineering as a coming trend.
4. Instrument Remote Control (IRC).
5. Brokerage systems for online labs, lab management and activity scheduling.
6. Proposals on learning object repositories for online laboratory components including norms, standards, management tools, generic and specific tools, user interfaces.
7. Integration online laboratories within shared collaborative learning environments; sharing software or hardware components.
9. Techniques and models of learning and teaching scenarios and tutoring systems including project and team based activities.
10. Mobile learning systems (m-Learning) dealing with mobile users, wireless systems, mobile devices and location awareness.
11. New manufacturing trends in the design of hardware and software interfaces, leading to potential universal modular design and low-cost, suitable user interfaces and equipment for remote laboratories.

Law of Disruption (see Fig. 1).

- Social, political, and economic systems change incrementally, but technology changes exponentially.
- Large differences between technology and other systems create disruption.
- Learning-on-demand and Life-long learning is the key to individual survival in this world of change.

2 E-LEARNING APPROACH TO WEB BASED TECHNOLOGIES

The term "e-Learning" means different things to different people. Numerous learning delivery media include electronic content and may be considered e-Learning. The American Society for Training and Development (ASTD) broadly defines e-Learning as covering a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, intranet/extranet (LAN/WAN), audio- and videotape, satellite broadcast, interactive TV, CD-ROM, and more.

Divisions between traditional, paper-based classroom training and computer-based training become increasingly blurred as new delivery methods become readily available and as multimedia

approaches to learning become more common. Whether students are gathered in a classroom, or engaged in e-Learning as a class or individually at remote locations, it is essential to understand when and how it is most appropriate to apply different delivery methods for each of your organization's learning solutions.

Basic forms of learning changed with new tools and approaches and with the direction of study branches. Main forms can be described as:

- Traditional Instructor-led Training
- Multimedia Learning
- Collaborative Learning
- Blended Learning
- e-Learning

2.2 Traditional Instructor-led Training

Learning that occurs in a classroom where an expert instructor teaches a group of students in person is typically described as instructor-led training (ILT). This type of training is usually faster, easier, and less expensive to design and develop than compelling e-learning since it does not require highly detailed materials (the instructor provides the details) and no programming (as in multimedia learning) is required.

ILT may also use electronic delivery media such as PowerPoint® slide presentation software and synchronous (live) or asynchronous (delayed) video conferencing, so it may also be considered a form of e-learning. It may also be delivered via the Internet as web-based training (WBT

Advantages, disadvantages and costs of instructor-led training

The greatest strength of ILT may, however, be considered a weakness. The quality of most ILT is dependent upon the knowledge and abilities of the instructors and the rapport instructors build with their learners. While live instructors are able to spontaneously adapt their style and content to meet the individual needs of their learners, they cannot ensure that every learner in a given course receives the same quality of instruction, even if the materials from which the instructors are teaching are standardized. While instructor-led training is often the solution learners prefer, and the lowest cost solution to design and develop, other costs associated with instructor-led training significantly increase the costs for delivery of ILT. Over time, the salaries and travel expenses of instructors can become significant for your organization. Since the number of students in a classroom is limited, instructors must present the same material over and over to different learners.

Time required for instructor-led training

The time assigned to learners to complete ILT is also significantly greater than the time that would be scheduled for learners to complete the equivalent amount of content in a multimedia format. This is because in ILT, the instructor sets the pace based on the average learner, while in multimedia, learners pace themselves. So, learners who could achieve more quickly are forced to proceed with their training at the pace of the group to complete the ILT course. Furthermore, during the time they spend out of the office in training, learners are not able to complete their regular job assignments.

2.3 Multimedia Learning

Multimedia learning may be delivered to learners on a CD or via a server as computer-based training (CBT) or via the Internet through a web-browser as web-based training (WBT). Multimedia, self-paced, stand-alone learning is significantly more costly and requires more time to develop than ILT; however, it has been shown to be more effective than instructor-led training in most instances. Over the long term, multimedia learning can result in cost savings because the alternate modes of delivering the training reduce the costs associated with live instructors: salaries, benefits, travel, etc.

Standardization and customization with multimedia learning

For optimal effectiveness, multimedia learning should be compelling. Learners may be able to apply the concepts they learn through simple interactions or complex simulations, resulting in greater retention and knowledge transfer. Multimedia also enables the standardization of learning across learners and the customization of learning to meet the individual needs of learners.

2.4 Collaborative Learning

Collaborative learning enables learners to work together on assignments or in lab situations. While activities or assignments may be planned and have formal objectives, the actual learning that results typically occurs spontaneously between learners. Collaborative learning may be used in the classroom or lab, over the Internet, or in informal and spontaneous situations.

2.5 Blended Learning

Blended learning is a relatively new buzz-word for something most instructional designers were taught early in their education or training, because learning something in a variety of ways and situations has long been considered the most effective means of learning. Blended learning is the combination of many different learning media (instructor-led training, multimedia, collaborative, etc.) in the formation of a given unit of training.

Benefits of blended learning

Blended solutions are most applicable when a given unit of instruction requires learners to be aware of, understand, apply, evaluate, and synthesize like information in different situations. For example, when training customer service representatives, the first part of an initial course may be e-learning that presents the representatives with basic information about your organization's products, services, and customer service philosophy. The second portion of the training may require them to meet in a classroom to discuss what they learned with other learners and an instructor, and then do collaborative role-playing activities. The final portion of the course may include simulations of real interactions with customers on which the customer service representatives are rated for their performance.

The intersection of instructor-led training, multimedia learning, and collaborative learning in the Venn diagram above shows how the combination of the three types of learning results in a blended learning solution.

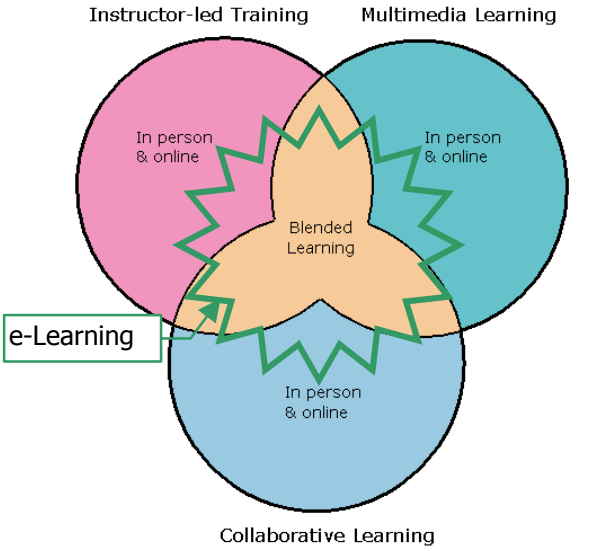

Fig 2: Overlap of *Instructor – led Training*, *Multimedia Learning* and *Collaborative Learning* with *Blended Learning* as an intersection of these basic learning forms and *e-Learning* as common part of all forms with dominant Web support.

2.6 e-Learning

New synthetic form covers a wide set of applications and learning processes, such as computer-based learning, digital collaboration, Web-based learning and virtual classrooms. It includes the delivery of content via audio- and videotape, CD-ROM, interactive TV, satellite broadcast and now mainly via Internet/intranet/extranet (by LAN/WAN/Wireless LAN) (see Fig. 2). Methods of e-learning can be interoperable, durable, reusable, and accessible (see Fig. 3).

2.7 m-Learning

M- learning offers a unique opportunity for teachers and students in different kinds of learning environment settings. The unique feature of this mode of learning is that it enhances flexibility for students; however, it demands new pedagogies, and new approaches to deliver a course. If appropriately facilitated, m-learning helps learners in a great way by providing virtual classrooms on their mobile devices.

Web services provide a means of integrating applications via the Internet. By using XML messaging to exchange data, Web services allow companies to link applications and conduct e-business regardless of the computing platforms or programming languages involved. Web services are quickly becoming the way to develop systems, for obvious reasons. They eliminate the major problems associated with network and distributed software, and they can provide a new source of revenue for companies that provide the service. The proposed web services based flexible services architecture could become a new direction for developing web services applications for mobile education [SHARMA & KITCHENS, 2004].

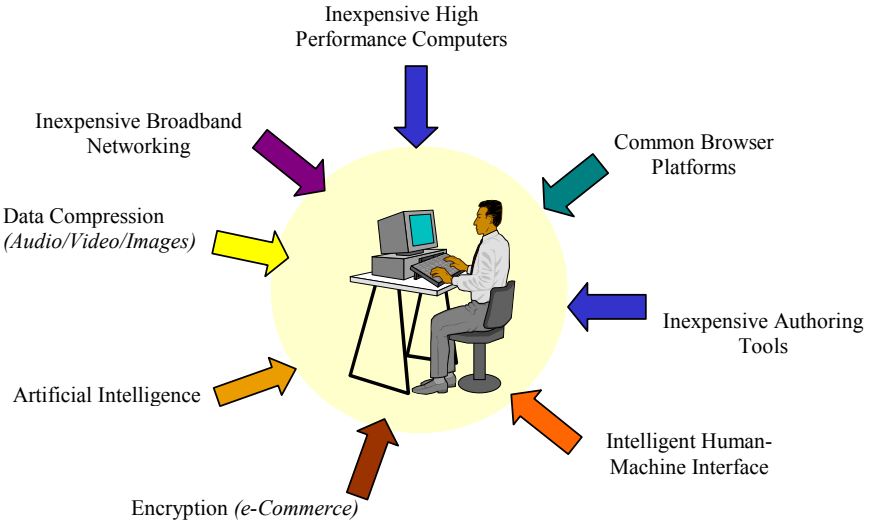

Fig. 3 Technologies for on-line learning

On the Figure 4 we can see the possibility of remote and virtual access and measurements over various computer networks as part of "virtual laboratory concept". There is combined the real laboratory experiment with measurement and control plants with remote access via Web environment with SCADA/MMI program support (for instance InTouch, Control Web).

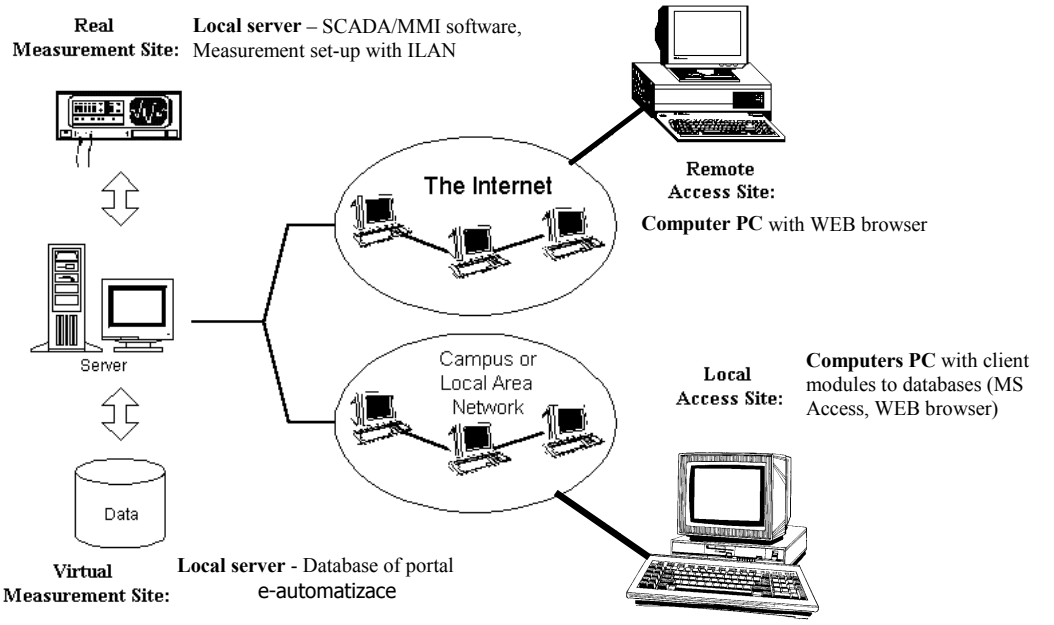

Fig. 4 Remote and virtual access and measurements over various computer networks

3 VIRTUAL TECHNOLOGIES WITH WEB SOLUTIONS

Learning technology systems and computer use in learning have a long history, almost as long as other mainstream computing applications (e.g., business data processing and scientific computations). Interest in and demand for e-learning technologies have grown dramatically in the last several years, paralleling the widespread deployment of personal computers with access to networks and mainly with WEB. Industry, learners and educators have all recognized that learning technology combined with ubiquitous network and hardware infrastructure, when properly applied, can increase the quality of learning, reduce costs, and improve access to learning.

However, this full potential has not been realized. For example, for any domain where you want to deliver education and training, it is likely that applicable digital assets (media, content, courses) and learning applications and tools (simulations, tutors) exist that can be used to create the desired learning experience. The problems are in finding these assets and applications, acquiring or otherwise accessing them, structuring them into the appropriate learning experience, delivering them within the organization's and learner's existing technology and network infrastructure, and linking their management and use to the existing management and backend office systems.

On the operational side, teachers focused on e-technologies supporting conventional practices, and the resulting learning environments are only automated versions of pre-technology systems (e.g., linear e-books versus standard text-books, computer- versus manually-mediated communications, presentation software versus overheads and viewfoils). We must understand and model the core learning and learning management processes and use these to engage in a deliberate process reengineering.

While we have proposed a model of Web services as a basis for behavioral components of learning technology systems, we have not agreed on the broader fundamental basis and assumptions for these systems. To provide a scientific basis for learning technologies, we must separate the fundamentals (e.g., representations, distributed agents and processing approaches, semantic and behavior models) from their realizations in particular technologies (e.g. Web services, Peer-to-Peer systems, XML or RDF).

Online learning can be beneficial for students with disabilities. For example, a student unable to attend lectures as a result of a disability may be able to participate via remote learning. Another example may be in the case of a student with a hearing impairment who finds it difficult to lip-read and keep up in lectures. The student could download the lecturer’s notes and PowerPoint presentation and review the subjects covered. Finally, a student who is visually impaired can access the PowerPoint presentation using a computer equipped with a screen-reader, thus allowing him to

'hear' what was being displayed on screen. Electronic texts are an essential component of any e-Learning environment. The way that the user interface is designed to support navigation in electronic texts is critical since it determines the way that the texts can be traversed and it is vital that navigation problems, such as 'feelings of lostness', are avoided.

On the next Figure 6 we can see the example of Web learning information support for students connecting the data about courses, courses content, list with detail course information and links to study materials (e-books).

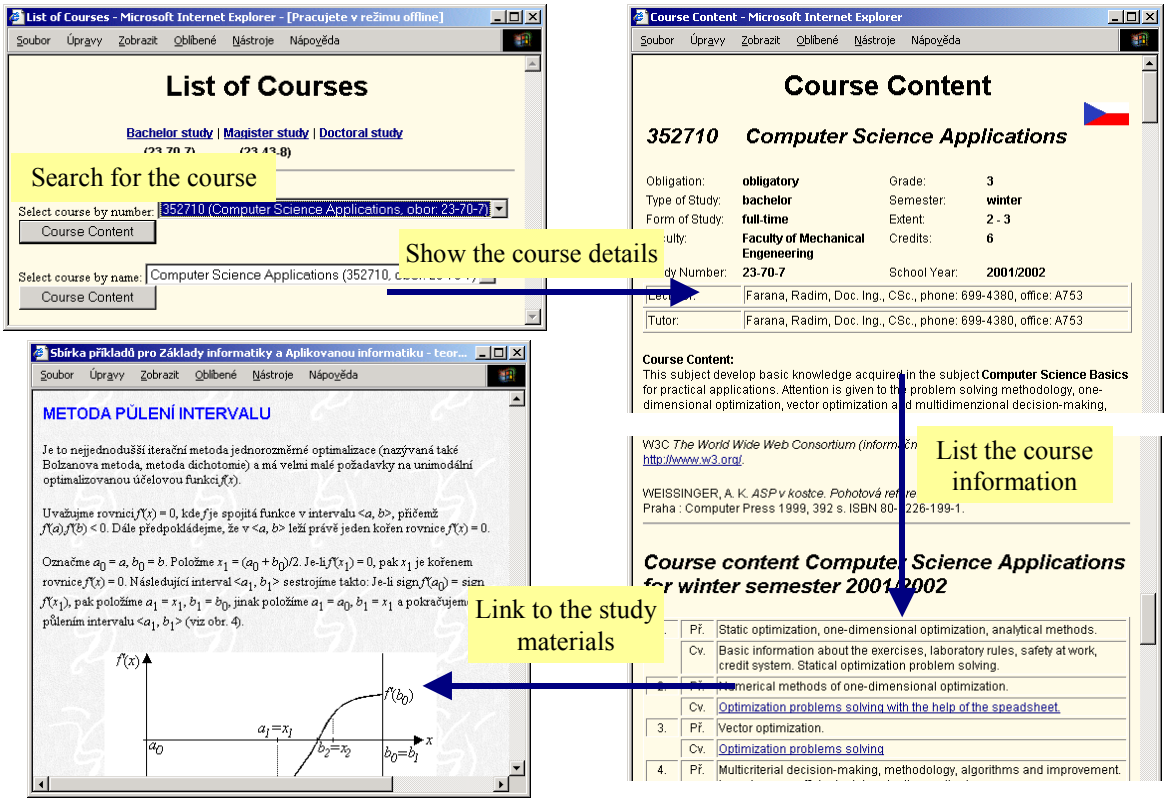

Fig. 6 Course content information system connected with electronic teaching texts

The new trends with Web technology support for e-learning introduces innovation both in pedagogy and technology. It aims at developing tools that will allow for as many links of science teaching as possible with every day life. Sometimes students loose interest in science because they cannot relate what they are being taught to their everyday lives. Laboratory education in e-learning aims at overcoming the barriers imposed by the traditional classroom setting by using an innovative combination of a new approach to learning and the development and application of new technologies.

Wearable computers and smart sensors have been developed that can be used by students to gather data, which can then be used to graph trends and patterns and investigate the laws of engineering and physics. Networks of schools gather data with Web support compare measurements and design new experimental activities on their own. In this way, teaching makes as many links as possible between the natural sciences and daily life, and research becomes more of a collective process.

4 WEB PORTAL E-AUTOMATIZACE

The Web is an interactive, dynamic, and rapidly changing new communications medium and every Web site should reflect this. Well-organized, edited, and timely original content set in an attractive, interactive, and consistent format are some traits of successful Web sites.

The goal of the Web portal e-Automatizace (http://e-automatizace.vsb.cz/) is to create an information access point into the automation field for students and academic staff and systematize information into logical hierarchy. Portal e-Automatizace is based on content management software PortalApp Basic Edition 2.21, which uses Active Server Pages and Access 2000 database for

storing data. As a result of the student survey the main Web page was changed to be more useable – emphasis was put on full text search and search form field was moved to main page. Other changes were implemented on the page with the catalogue of links. A hierarchy of links is at the top of every catalogue page and is visibly separately from the list of links. Additional information (rates & views of a link, report errors) was united into one group. Also title of link was highlighted (see the Figure 7).

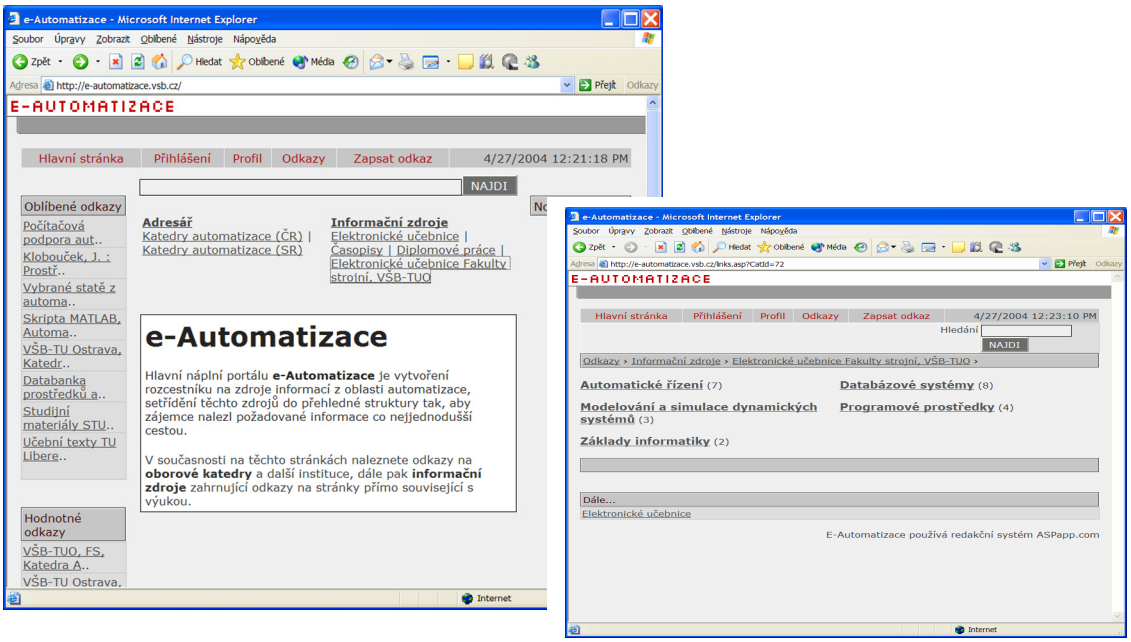

Fig. 7: WEB Portal e-Automatization and its possibility for education goals.

5 CONCLUSION

In today's working environment, employees have to collect, make sense of and use more and more information to keep up with developments in their field. To make the most of this information they need to acquire new knowledge and skills and develop better ways to collaborate with fellow workers based at different locations. The e-learning methods and tools can solved these problems and designed to develop a learning environment that gives users remote access to a virtual workspace for collaborative inquiry-based learning using experimentation and modeling. In parallel with the technical development of the new virtual learning environment mainly on Web environment, a comprehensive support system is developed to help learners in their experimentation, collaboration and assessing activities.

Using electronic media for learning and teaching is widespread. E-Learning offers opportunities for staff to convey material in a variety of ways and ultimately on 'anytime, anyplace' basis. E-learning materials and Web technologies can range from the simple act of putting lecture notes on line to simulations of real life. This means that distance learning (both off and on campus) is a realistic possibility, with students able to take part in class discussions via email and online discussion forums, and at the same time being able to remotely access materials and information. These materials do not need to be static web pages, as technologies such as broadband improve audio and video may be made available on a faculty Intranet/Internet allowing students to review material already covered, or prepare for lectures and tutorials.

Any e-Learning system is valuable only if it is able to facilitate learning through leveraging of Information and Web Technology to achieve high efficiency, reduce cost and increase the opportunity for learning for its users.

6 ACKNOWLEDGEMENTS

The presented results have been obtained with the support of the Czech Ministry of Education, Youth and Sports, during completing of research project MSM 272300012.

REFERENCES

BING DUAN, KECK,VOON LING & HABIB MIR M. HOSSEINI. Developing a Framework for Online Laboratory Learning Objects. In *Proceedings of WSEAS ICECS and WSEAS E-Activities* 2003, Vol, 5. Sentosa (Singapore): Dec.7-9, 2003. pp. 467-157.

FARANA, R. & SMUTNÝ, L. Developing and Remote Control of Web Information Systems. In *Proceedings of 3rd International Carpathian Control Conference*. Ostrava : VŠB-TU Ostrava, 27. - 30. 5. 2002, s. 487-492. ISBN 80-248-0089-6.

PASINI, N. *The Role of SCORM in E-learning*. Learning Systems Architecture Lab Carnegie Mellon University, Pittsburgh, 2002. [Web on line: http://www.lsal.cmu.edu].

REHAK, D.R. *Learning Process Engineering: A Science of Design for Learning Technology Systems*. Pittsburgh (PA): Learning Systems Architecture Lab, Carnegie Mellon University. 2002. [Web on line: http://www.lsal.cmu.edu/].

RODRÍGUEZ, Judith S., ANIDO-RIFÓN, Luis E., FERNÁNDEZ IGLESIAS, Manuel J., MIKIC, Fernando A., ÁLVÁREZ, Luis M. A Web Services Broker for E-learning. In *Proceedings of International Conference on Computational Science.* 2003. pp. 659-668.

SHARMA, Sushil K. & KITCHENS, Fred L. Web Services Architecture for M-Learning. Miller College of Business, Ball State University, USA. *Electronic Journal of e-Learning.* Issue of EJEL: Vol. 2, Issue 1, March 2004. Web: http://www.ejel.org/volume-2/vol2-issue1/issue1-art2.htm .

SMUTNÝ, L. Measurement and Control of Experimental and Virtual Lab Stands for Improvement of Quality Education. In *Proceedings of XXVIII Seminary ASR 2003 „Instruments and Control"*. Ostrava : VŠB-TU Ostrava, 6. 5. 2003, pp. 321-328. ISBN 80-248-0326-7.

352LAB:2004. *WEB pages of Dep. CSI Laboratories*. (Portal). Available from web: <URL: http://352lab.vsb.cz >