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E-Learning: An Effective virtual way to understand the physical world

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ABSTRACT
The objective of physical laboratory training is to provide an experimental base for the theoretical concepts introduced during the lectures. It gives an opportunity to students to verify ideas which they learn in theory classes. Practical ability to perform experiments, record and analyze data is usually acquired through practice. Practice is essential to being able to make the connection between theory and experiment. E-learning platform creates the environment which is useful in achieving such connectivity. Present work emphasizes on need of implementation of Virtual experimental sessions as a model of E-learning to provide interactive multimedia contents to the students to higher their interests in understanding 3D physical world with computer models of real systems.

Keywords - Virtual laboratory, remote laboratory, E-Learning

Introduction

In Current Scenario, The Culture Of Education Is Changing With Time Hence The Roles Of Teachers And Tutors Along With teaching and learning pedagogy are also changing. This is why E-learning came into existence.

According to the definition, E-learning means using combination of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to facilities and services as well as remote exchanges and collaboration programs. In the process of E-learning, maximum interactivity is reached by means of electronic communication. It also brings flexibility to usage time, pace and place of study, content, instructional approaches and resources.

Remote labs and virtual labs are two different models of E-learning process. Virtual and remote laboratories can be accessed at any time from any place where the Internet connection is available. **Remote laboratories** allow users to manipulate real equipment by means of a computer that is linked up to the actual laboratory equipment via a network. Remote labs are very interesting for students as real signals measured on remote hardware are provided to the students. Thus students genuinely practice the influence of different controllers and they can do it comfortably from their homes using Internet connection. Usually remote laboratories are realized in the form of client-server applications using Java or .NET platform and commercial products Lab View or Matlab/Simulink, or open products like Scilab/Scicos or OpenModelica.

On other hand, **Virtual Laboratories** provide the platform where the experiments are performed in the form of simulations using computers. Simulations which attempt to represent the real laboratory experiments as closely as possible are called virtual labs. This paper aims at discussing the modern technology of virtual laboratory, as a model of E-learning and its importance in teaching various disciplines of science.

Definition of Virtual Laboratories

It was defined as "laboratory experiment without real laboratory with its walls and doors. It enables the learner to link between the theoretical aspect and the practical one, without papers and pens. It is electronically programmed in computer in order

to simulate the real experiments inside the real laboratories." (Harry & Edward, 2005). In addition, it was defined as "A virtual studying and learning environment aims at developing the lab skills of students. This environment is located on one of the internet pages. Usually, this page has main page & many links, which are related to laboratory activities & its achievements (Zaitoon, 2005).

Why Virtual Laboratories?

Theory and practical, these are the two important aspects of educational process. Practical play an important role as they are helpful in presenting abstract ideas that may be hard to visualize or explain. Here virtual labs work as a link between the physical world and abstract world.

Virtual Lab is a complete Learning Management System. All the relevant information including the theory, lab-manual, additional web-resources, video-lectures, animated demonstrations and self-evaluation are available at one common place. Virtual Labs can be used in a complementary manner to enhance the effectiveness of theory-based lectures. Small projects can also be carried out using some of the Virtual Labs. Virtual Labs can be effectively used to give lab-demonstrations to large classes. A virtual laboratory also gives freedom to the students to virtually manipulate the real systems modeled in computers in the desired way.

Setting up and construction of standard laboratory is the matter of time and economical resources. However, it is outside the scope of many institutions. A solution to this problem could be found in the adaptation of Virtual Laboratories as it is helpful in cost reduction. The broad objective of education is acquired through resource sharing which becomes a reality by optimal utilization of costly equipments. To facilitate the access to educational and research material for both students and professionals is also important part of educational process. Reduction in travel time also leads to productivity enrichment. Virtual laboratories also adds the flexibility to accommodate make-ups for the students who miss the class for any reason as it is hard to keep equipment and supplies set up for such students for an extended time. Providing a link to a virtual lab or simulation could be done for such students. Safety is one of the important aspect in labs which cannot be overlooked, virtual labs increases safety for dangerous experimentation.

Basic Requirement of Virtual Lab

The main components of the virtual labs are as follows

1. Computer devices linked to the local net, so that the student can work directly in the lab, or distantly at anywhere and anytime.
2. For electronic execution of experiments all apparatus should be linked to the computer hence communication network & the related hardware must be upto the mark as the digital communication works as a link between the user and laboratory.
3. E-L simulations, the simulations are a very effective teaching tool. The Programs of the Virtual Lab are represented in the form of simulation programs. These programs are designed by professionals having good software skills and are very difficult to produce. Also, development of simulations consumes a lot of time. This often requires knowledge of several software packs and skills to present the simulation in a suitable, pedagogical way. However, one specific problem with simulations is their relatively short life cycle that is less than five years in general. The main reason for this is the upgradation of software platform, which in most cases affects the performance of the simulation. Quick spreading of simulation tools can be done with regularly updated list of available simulations. Among the earliest developments in this field include the Gamma Camera DOS-simulator learning pack, developed some 15 years ago with the support of International Atomic Energy Agency (IAEA), the Power Lab Systems of AD Instruments, various Lab View simulations, the IPEM X-ray Spectrum Processor software, etc. Other existing simulations are described in the special issue on e-Learning of JMEP. Other examples of simulations can be found at the web sites of some manufacturers and professional societies such as AAPM, IPEM, etc.
4. Simulations are intended to transfer conceptual and practical knowledge. Since this knowledge refers to the preparation, the performance and the evaluation of laboratory experiments, it is necessary to impart both

background knowledge and also knowledge referring to actually carrying out the experiment hence the virtual lab may not be the alternative to conventional hands-on laboratories thus the existence of the conventional lab is very necessary.

5. In order to attract and cater more and more students programs should be designed in an interesting and captive manner by using animations, videos and 3D pictures.
6. Last but not the least, it is important to have specialized working staff, instructors and curriculum experts for designing and production, in addition to evaluating the program to determine its efficacy. In addition a technical team is also required to support educators in preparing and assessing scientific materials.

Basic Function

In India, it is a project initiated by the Ministry of Human Resource Development, Government of India, under the National Mission on Education through Information and Communication Technology. It is free of cost to the user. The common website link to access all Virtual Labs is www.vlab.co.in. Any user can access Virtual Labs using a PC and broadband connectivity.

On the Virtual Labs home page (www.vlab.co.in), the Virtual labs are divided into two categories i.e. discipline wise and institute wise. The user can click on any of the categories to find out the lab of his/her preference. Download Links for all the software required to use the labs are provided on each lab's homepage (wherever required). All the relevant software is free to download and information on how to download, install and use the software is also provided.

There are two types of Virtual Labs, Simulation Based Virtual Labs and Remote Triggered Virtual Labs. Registration requirements are different for the two categories.

Simulation Based Virtual Labs

In these Virtual Labs, the experiments are modeled using mathematical equations. The simulations are carried out remotely at a high end server, and the results are communicated to the student over the internet. This class of Virtual Labs, at best, mimics the real-world scenarios/experiments. Simulation based Virtual Labs are scalable and can cater to a large number of simultaneous users. Many of the simulation based labs do not require any registration. One can directly perform the experiment without registering his/herself. On the other hand, some of the simulation virtual labs require one-time registration. The availability of simulation based labs is 24 x 7 including weekends.

REMOTE TRIGGERED VIRTUAL LABS

In these Virtual Labs, the actual experiments are triggered remotely. There is limitation over time slot as the user can use them as per the time mentioned on the website. The output of the experiment (being conducted remotely) given to the students is of real time experiments which are communicated back to the student over the internet. Remote Triggered Virtual Labs are difficult to scale and can cater to a limited number of users. Typically, time-slots are booked before conducting such experiments. To access a remote triggered lab, a user has to book a slot. For booking a slot, user has to register himself first and then book a slot from the slot chart. All the available /booked slots can be viewed on this chart. Once a request for slot-booking is made, all the information regarding the user id, password and the slot booked is sent to the user's email address provided by the user at the time of registration. Once registered, the same credentials can be used every time for login. This registration has to be done by the user separately for each of the remote triggered virtual labs.

The users can email their queries to the virtual labs support team at support@vlab.co.in.

Conclusions

With a steady increase in bandwidth and decrease in response time, internet has become an indispensible part of our learning process. The role of conventional laboratories for training and understanding educational problems is presently being challenged as the advances made by Information Technology show the way to create the environment for the implementations of E-learning models, thereby overcoming some limitations of the conventional lecture-classroom-laboratory system. E-learning paves the path for exploring and understanding abstract world on experimental basis rather than understanding through mathematical formulations. It changes our perception towards physical world as to "perceive" with a traditional equation-based

approach is totally different from to "perceive" with the simulation.

Virtual labs, as one of the models of E-learning, uses simulations to create interactive tutorials that provide students a visual demonstration of techniques or experiments. In conventional labs, students have only a short time to understand the project or work assigned while virtual labs provide unlimited access to class materials, thus facilitating better understanding. Virtual labs cannot replace hands-on training as yet, but the use of interactive simulations gives students an idea of what to expect in the real lab, this saves a lot of time spent in learning new methods.

References

1. Scheckle R A, "Virtual labs: a substitute for traditional labs?", Vol. 47, Nos. 2/3,pp. 231–236,2003.
2. Huang C, "Virtual labs: E-learning for tomorrow", PLoS Biol. 2, e157, 2004.
3. Zaitoun H, "New Vision in Electronic Learning". Aldar Al-Soltiah, Riyadh, 2005.
4. Lal Z, and A Al-Gindi, "Electronic Communication and Education Technology" , T3, Al-Obaikan, Riyadh. 2005.
5. Harry E and Edward B, "Making Real Virtual Lab" , The Science Education Review, 2005.
6. Dillon S, "Virtual Science Labs", New York Times Upfront, fed, 193, 10, Research Library. 26. 2007.
7. Ray S et al.," Virtual labs in proteomics: New E-Learning tools", J. Proteomics. 75,pp.2515-2525, 2012.
8. Srivastava S et al., "Online education: E-learning booster in developing world", Nature 501, 316, 2013.
9. De Jong T et al., "Physical and virtual laboratories in science and engineering education", Science 340, pp.305-308,2013.
10. Srivastava S et al., "Online education: E-learning booster in developing world" Nature 501, 316, 2013.
11. Myneni L S et al., "An interactive and intelligent learning system for physics education", IEEE Transactions on Learning Technologies, 6 (3), pp. 228-239, 2013.
12. Venugopal G and Jain R, "Influence of learning Management System On Student Engagement", IEEE, 3rd international conference on MOOCs, innovation and technology in education,(MITE), pp. 427-432, 2015.
13. Liu D et al., "Integration of Virtual Labs into Science E-learning" ScienceDirect, Vol. 75, pp.95-102, 2015.