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Virtual Lab: A Supplement for Traditional Lab to School Students

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ABSTRACT

Learning science in the school is essential for the all students. The learning become easier and more concrete for the students if the Teaching become effective. Students in the schools very active and curious to learn science in the laboratory than the traditional classroom. Students need any innovative method of learning science. Every day the innovation in the application of Technology in the field of education is limitless. Technology act as assistance for learning science. Any easy or abstract and difficult concepts can be learnt easily with the help of animated videos, pictures etc. Laboratory experiments through Virtual learning is one of the innovative approach for learning science. In most of the schools the laboratory facilities are not upto the level. Lack of laboratory equipment is commonly prevailing in most of the schools hence the Virtual laboratory is the substitute for traditional laboratory. Through Virtual laboratory students can perform the experiments virtually through animated videos, also students can watch any experiments in anytime and anywhere in the computer or mobile. They can understand the concepts easily by watching videos. Virtual laboratory was already developed for higher education by MHRD, India, many University and colleges established virtual lab centres under the assistance of MHRD but in school education the concept of Virtual lab not much familiar. Virtual lab is very essential for the school students as a substitute for traditional laboratory. The Virtual laboratory has many advantages for the students. The one of the most important advantage is that the more difficult and hazardous experiments can be done virtually. The virtual lab is not replace the traditional lab however it act as substitute laboratory for learning science.

1. Introduction

Science is embedded in human life, it is intellectual pursuit of truth. Creation of science begins with observation leads to verification and formulation of theory. It is well understood that scientific phenomena does not exist without human curious observation and systematic study. Science and Laboratory are inseparable, laboratory plays significant role for studying the science. Scientist formulate theory based on repeated observation and verification. Instead of just reading and understanding or memorising the concepts from the textbook, science can be best learn through laboratory. In schools, Laboratory experiments and activities play vital role in learning science and it develop students' creativity and scientific attitude. Generally in schools traditional science laboratory helps the students to demonstrate the experiments. Developing nations like India, most of the schools the lab facilities are poor in terms of lack of building, scientific equipment's, over-crowded students, insufficient lab conditions, and scarcity of Science Teachers. Most of the time science teaching only confined to classroom. Students unable to perform any experiments or rarely provided opportunity to do practicals or experiments. In the late 1900s, the National Science Teachers' Association (NSTA) in the United States agreed that laboratory experience is "so integral to the nature of science that must be included in every science program for every student (NSTA, 2005). Laboratory activities develop a wide variety of investigative, organizational, creative, and communicative skills. NCF (2005) stated that laboratory exposure for the students is first priority. Traditional Science laboratory helps the students to perform experiments, in addition to the traditional science lab, technology based online virtual lab is an alternative options for the students to perform science experiments in an animated or simulated form. The Technology based virtual lab will not replace the traditional lab but it acts as supplement for traditional lab wherein students can trail out experiments before they demonstrate it in traditional lab, also they can repeat the experiments as many times they need it. Already CBSE endorsed online lab as a teaching aid for all its schools. This virtual lab benefits in many ways for Teachers and students such as saving time, less maintenance, no need of costly equipment's, some dangerous experiments need not to do and so on. MHRD, Government of India under the National Mission on Education through Information and Communication Technology (NMEICT) already initiated the Virtual lab for higher education and many University and Institutes running Virtual lab centre. Also, OLabs for School Education initiated by Amrita Vishwa Vidyapeetham funded by Ministry of Electronics and Information Technology, India provides online laboratory for school students. Similarly, CBSE also promoting OLabs for IX and X school students. Hence Virtual lab is one of the innovative option for providing laboratory experience. There can be many advantages of virtual lab however virtual laboratory will not provide hands on experience hence it cannot replace the traditional lab because working with real apparatus and equipment makes the learner to acquire the skills. Virtual lab give experience to the students that how to perform or demonstrate the experiments in real laboratory. Therefore computer based lab is an alternatives for the traditional laboratory, it was stated by Kiyici and Yumusak (2005) that the use of educational technologies particularly computer software

laboratory can be a better option. It is one of the supplement lab to perform animated experiments virtually. Sometimes scientific experiments cannot be studied experimentally because its dangerous in nature, more costly, maintenance and not updated instruments. In such conditions simulated experiments can be done through virtual lab. Research studies reported that computer simulation experiments are more effective (Douglas 1990; Lewis 1993; Greenbowe 1994; Russell et al. 1997, Svec & Anderson, 1995; Redish et al., 1997). There are many studies findings revealed that the role of virtual labs develops academic achievement, providing awareness of scientific concepts, and modifying misconceptions (AlSharhan, 2009, Lal and Al-Gindi, 2009, Hartinez 2003). Research findings reveals that instead of performing dangerous, difficult or impossible experiments, simulations have advantages from the time, security, cost and motivation point of view (Rodrigues, 1997 and Tekdal, 2002). All the research studies reveals that the Virtual lab is in innovative laboratory for the school students. Country like India many schools suffering due to unsatisfactory laboratory facilities, lack of enough science teachers, even if science teachers are available it is question that how frequently science experiments are conducted and demonstration of experiments are taking place in the class (Ramesh,2015). Therefore Virtual lab is an alternative and cost effective resources for the students to explore and understand the scientific knowledge and skills.

2. Concept of Virtual Laboratory

The meaning and concept of Virtual laboratory defined by different scholars: Virtual laboratories use computers to provide highly interactive virtual reality simulations of laboratory exercises." www.cnx.org/content/m18036/1.1. "A virtual laboratory is one where the student interacts with an experiment or activity which is intrinsically remote from the student or which has no immediate physical reality." www.web.phys.ksu.edu/icpe/Publications/teach2/Hatherly.pdf. "A laboratory experiment without real laboratory with its walls and doors" Harry and Edward (2005). "Virtual labs use the power of computerized models and simulations and a variety of other instructional technologies to replace face-to-face lab activities." Scheckler (2003). "Virtual studying and learning environment that simulates the real laboratory." Babateen (2011). "A virtual laboratory is a computer-based activity where students interact with an experimental apparatus or other activity via a computer interface." www.web.phys.ksu.edu/icpe/Publications/teach2/Hatherly.pdf. A distilled definition of the virtual laboratory that is consistent with the ideas advanced in this research is given below:

"A virtual laboratory is a set-up consisting of computer hardware and software designed to simulate, as closely as possible, traditional physical laboratory activities for the purpose of imparting comparable knowledge and skills to learners." Hatherly (www.web.phys.ksu.edu/icpe/Publications/teach2/Hatherly.pdf) makes an important distinction between simulations, computer-controlled experiments and a remote-controlled experiment. The simulated experiment involves a student interacting with programmed-in behaviours. Computer-controlled experiments involve a student directly controlling an apparatus in his/her vicinity via a computer interface. Remote-controlled experiments involve a student interacting with real apparatus via a computer link, yet the student is remote from that apparatus.

3. Salient Features of Virtual Laboratory

- Students Can access Virtual lab in anytime and anywhere to operate and can learn scientific concepts.
- It can be accessed through internet in personnel computer, Laptops, and smartphones.
- It function as self-learning modes, also students can self-evaluate their learning progress.
- Innovative and most dangerous experiments can be performed with the help of virtual lab.
- It promote group learning and collaborative learning.

4. Types of Virtual Laboratory

Simulation based Virtual Labs: This is scalable and can cater to a large number of simultaneous users. The simulation based labs are available 24x7 including weekends. Remote Triggered Virtual Labs: In these Virtual Labs, the actual experiments are triggered remotely. The output of the experiment (being conducted remotely) is communicated back to the student over the internet. This class of Virtual Labs, gives the student the output of real-time experiments. 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 (https://web.phys.ksu.edu/icpe/publications/teach2/hatherly.pdf).

5. Advantages of Virtual Lab

The following are the advantages of using Virtual Lab:

- In all the schools, upto tenth class, students should study science as an integrated subject but in most of the schools have no access to physical labs, virtual lab is an option to perform experiments in an animated form. However, students can use the Virtual lab as a supplement resource in the schools have physical lab.
- Sometimes students cannot perform some dangerous experiments or costly or complicated equipment's may not available in traditional real, in such cases virtual laboratory can be used to perform the experiment in a simulated manner.
- Students can operate the virtual lab even in offline also wherein students can download the experiments and they can watch or perform experiments any time and anywhere.
- With the help of virtual lab students can demonstrate the Experimentation before performing experiments in Traditional lab, by doing so, they will get familiarity with the apparatus, setting up apparatus.
- Students can observe, predict, hypothesis, infer the results while/after doing experiments.
- After completion of experiments in computer, students can do self-assessment about their knowledge and skills and they will be getting regular feedback.

- Performing experiments in Virtual lab helps the students to gain pre-lab experience and it will give some idea about what they will encounter in traditional lab during actual experiment.
- By doing experiments in Virtual lab, they will get theoretical knowledge and it remove misconceptions. Also students will get motivation and interest.
- Students can try out or make science models and it can used as learning aid.
- Virtual lab is connected with other schools, Institutes hence students will get opportunity to discuss, share and communicate with other experts, Teachers and students.
- It can be possible that large amount of data can be stored and it can be retrieved whenever students required for comparison.
- It enhance scientific thinking, creativity and problem solving and other skills.
- A virtual laboratory is one where the student interacts with an experiment or activity which is intrinsically remote from the student or which has no immediate physical reality.

6. How Virtual Lab Supplement for Traditional lab

Virtual laboratories act as a complement and substitute for traditional laboratories. It overcome the limitations of real laboratories. The virtual lab is an additional pedagogical resource for demonstrating the experiments virtually in which students gain knowledge and skills. Also students can be involved in doing experiments by integrating with Virtual lab and traditional lab. The various animated experiments designed and developed in virtual lab using software and hardware. The theory and procedure of all experiments are well stated, students first learn the concepts behind each experiments and then they can practice to do experiments in the computer or in a mobile, thereafter they can do experiments in the Virtual lab, the same experiments can demonstrate in the traditional lab too. By doing so, students will avoid any kind of errors and mistakes. The virtual lab experiments give accurate results and the same experiment accuracy can be verified in the real lab. Students can build more confidence to perform experiments in real laboratory. Also certain experiments are very hazardous to do in traditional lab, and certain experiments unable to perform in the traditional lab due to lack of equipment or very costly in nature, in such situation virtual lab help the students to perform the experiments virtually. Physics and chemistry experiments can be demonstrated and animated dissection in biology can be done easily. Also students can have a collaboration with other school schools through online for sharing the knowledge and learning experiences. It is the greater advantages for the students that they can check their learning progress frequently. Very frequently the software and hardware can be updated according to requirements hence there will not be a problems in terms of maintenance of equipment and chemicals. Experiment in virtual lab help the students to observe and collect the data, also they can make prediction and hypotheses. School students are very interested in using Mobile and computer therefore they can operate the virtual lab website or application very easily. In virtual lab, Teachers not required always for performing lab experiments, students can learn in their own pace and style. They will become very interesting and active in their learning, and provide rich experiences to construct and understand basic and higher level scientific concepts in an easy manner.

7. Conclusion

It was stated by NCF (Position paper-2006) that Research into existing and new techniques, strategies and technologies for solving problems of education, enabling judicious and appropriate application of technology. Appreciation of the role of Educational Technology as an agent of change in the classroom, influencing the teacher and the teaching-learning process, and its role in systemic issues like reach, equity, and quality. In a nut shell Virtual lab is an innovative supplement resources for the students to solve certain problems such as lack of laboratory, equipment and Teachers in schools. Its only require computer or mobile for students to learn and understand theory and experimental procedure, they can perform and watch and store experiments virtually. It overcomes some of the problems which are faced in traditional laboratories to learn science.

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