

**Supporting class room teaching with virtual labs –for enhancing the effectiveness of science learning.**

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**Abstract:** The use of information and communication technologies (ICTs) at different educational levels has impacted the teaching-learning process. Virtual learning environments (VLEs) are widely used in foreign countries, offering advantages to both students and instructors. Numerous research works have been noted during the literature survey which highlights the significance of virtual laboratories in schools and colleges. The objective of this paper is to emphasize the importance of using virtual laboratories for science teaching in schools and colleges in India. Issues which are responsible for the less efficiency in teaching-learning processes have been mentioned. The advantages of using virtual laboratories have been discussed in the article.

**Introduction**

During the last decades, the information and communication technology (ICT) has witnessed a rapid development in all fields. Due to the developments in ICT, the resources of knowledge became various and numerous. The course of science is obviously connected with technology, both cognitively and practically. Enormous discussions are going on regarding the integration of ICT in teaching-learning process.

Around the world, a number of studies have shown that interest of students in science & technology declines school years. Policy-makers worldwide recommend including scientific investigations in courses for students of all ages (1, 2). Physical, hands-on investigations typically fill this need, but computer technologies now offer virtual laboratories where investigations involve simulated material and apparatus. The value of physical laboratories for science learning is generally recognized (1), but the value of virtual, simulated alternatives for hands-on physical laboratories is contested (3). Virtual laboratories are considered the main underpinning in practical electronic learning, seeing that virtual labs closely resemble real labs (4,5). Several studies emphasized the vital role of virtual labs in developing academic achievement and providing awareness of scientific concepts.

Introduction of virtual labs is an advantageous situation in the chemical education, when students can perform individually most of the chemical experiments covered by the curriculum, (6). In this case, the work of students in the laboratory has a positive effect on the process of teaching and learning (7), in which laboratory environment plays a very important role. Teachers of science confirm that the active work of students in the laboratory provides measurable benefits in teaching (8). Also, educators claim that the teaching of chemistry, which is the Natural Science subject, is most effective when students work in the laboratory having direct contact with matter being converted (9).

In addition, the laboratory exercises, which are a form of realization of practical teaching methods and the associated intellectual activity of students, such as reasoning, critical thinking and scientific prediction cause an increase in theoretical and laboratory-based problem solving skills (10,11). With the acquired skills, students are motivated to independent, critical thinking and the design of experiments and research in a way in which scientists do. The main goal of an educational virtual laboratory is to provide all the simulations, tools, applications and conditions necessary, which will constitute an efficient space where experimentation, communication and collaboration can be used for the maintenance and exchange of rich knowledge (12).

This paper discusses briefly the reasons for the poor quality of science education in India. The work suggests the introduction of virtual laboratories in schools and colleges to enhance the effectiveness of teaching-learning processes.

### **Virtual laboratories-scope in India**

Science education includes reasoning, curiosity, creativity and problem solving approach. These are some of the qualities which must be developed in each and every citizen. For the betterment and development of every country the science education is essential. The quality of science education depends mainly on the quality of curriculum, teaching methodology adopted, availability of infrastructural facilities connected to class room and laboratories, type of learning materials used etc. Science and technology are categories which are highly interdependent but distinct. Science contributes to technology in many ways. For instance, science provides new knowledge which serves as a direct source of ideas for new technological possibilities. Similarly, science is the knowledge base that enables more

efficient strategies of applied research and development of new technologies. India is known all round the world for its scientific outputs and its effective performance in the field of information technology. However, India is still lagging in science and technology compared to developed countries. There is widespread concern about the outcomes of science education at schools and colleges in India. One of the important steps to be taken for bringing India to the forefront in technology is to improve the quality of science education at all levels.

Some of the important issues noted in science education at Indian schools and colleges are (1)Un-updated and less frequently revised curriculum (2)more emphasis to conventional teaching-learning processes (3) less importance to practical's/hands-on training (4) lack of relevant quality improvement training programme for teachers (5) non availability of the infrastructural facilities required by the curriculum (6) lack of self motivation in students (7)examination focussed coaching and learning etc

Methods to enhance the quality of science education have been discussed widely. This paper focuses on the incorporation of virtual laboratories to enhance the efficiency of teaching-learning processes. There are opinions that, educational professionals consider the importance of integrating information and communication technology in science learning, as to facilitate studying many scientific phenomena that cannot be studied experimentally due to its danger, high cost, or lack of time to complete the experiment. In fact, the primary aim of providing virtual learning environments is to both enhance the level of learning and improve the quality of education. Moreover, a technology-enriched environment would greatly enhances students' motivation and develop positive attitude towards the program.

Practical experience is an important component of the educational process. However, the time and economical resources required for the setting up and construction of well equipped scientific laboratories is outside the scope of many institutions. A solution to the above problem could be found in the adaptation of Virtual Laboratories, which could be proven as an important educational tool that deals with the lack of practical experience in education. Virtual laboratories should not be considered as a substitute for physical laboratories in schools and colleges. Physical laboratories have great advantages like it helps better understanding of concepts, inculcate hard skills etc. Current situation is, practical's connected to only certain concepts studied in theory teaching are given in physical laboratories. Many of the import concepts related to science subjects do not appear in the syllabus for practical's

due to various reasons. Here comes the importance of virtual labs. Virtual labs can be used to support class room teaching. One of the important capabilities of the virtual lab technology is the translation of concepts into visualized events along with the possibility of the users' interaction with them, that in real life could be limited due to distance, time and safety factors. In virtual labs, students can simulate the performance of laboratory activities similar to those that they perform in a physical laboratory. Working in a virtual laboratory results in greater emotional involvement and an increased sense of self-efficacy in the laboratory work among students. As a consequence, students may show more interest in the subjects. Virtual Reality provides a friendly representation of the provided information, interaction with the system, which does not require advanced knowledge of the computers technology and reduced cost compared to other technologies. In addition, one of the most important aspects of this proposal is the fact that the development of virtual laboratories can be fully supported by the existing computer laboratories, without the need of additional investments and infrastructure.

Physical laboratories are important and need to be retained as much as possible. At the same time, the concepts which cannot be practiced in real labs due to any reason can be introduced as virtual labs. The virtual lab facility can either be integrated to the class room or provided in the existing/special computer labs. This facility can be applied right from lower primary classes. Introduction of virtual labs in teaching may enhance the learning level of students, arouse curiosity and make science an interesting area in curriculum.

### **Conclusion**

Traditionally, the laboratory has been an integral component of education for relating concepts to real-world phenomena. Unfortunately, the lecture class room- laboratory system has its flaws or demanding requirements and the role of conventional laboratories for training and understanding educational problems is being challenged. The advances made by information technology have led to some processes which can overcome some limitations of the traditional lecture-classroom-laboratory system. The concept of virtual laboratories is helpful to address some of the challenges in science teaching. Virtual labs are useful in cases where physical laboratories cannot be applied due to time constraints or hazards. Virtual labs are economical and helpful in case of experiments that can be simulated only in computers.

Above all, the introduction of virtual labs in teaching may increase the gained information by students and enhance the retention of knowledge.

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