

Chapter 14

Role of Virtual Laboratories in Teaching Learning Processes of India

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ABSTRACT

Laboratory training and exercises provide hands-on experience to the students. However, the limitations in the laboratory facilities in the engineering colleges may affect the teaching and learning process of the future engineers. Hence, Government of India has started an initiative called Virtual Lab to overcome this issue. The premier institutions in India were funded and these institutes are the nodal centre in providing virtual lab facilities to colleges which do not have sophisticated laboratory facilities. The advancement in IT and internet facilities can no more hamper students and researchers in enhancing their skills and knowledge. Also, in a country such as India, costly instruments and equipment need to be shared with fellow researchers to the greatest extent possible. This chapter discusses and highlights the Virtual Lab initiatives and implementations.

INTRODUCTION

The development of any country depends upon the skilled manpower and educated population. The education increases productivity and creativity of the people and also and promotes technological advancement. It plays a crucial role in country's economic growth and social progress. India's educational policy focuses on improvement in literacy rate and a number of initiatives were taken to promote primary and higher education. The importance is given in science and engineering education to improve employability and to meet demand of the industries. The effectiveness of teaching and learning process is very important to impart necessary knowledge to the students (Lynette, et al. 2010). The younger population

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is high in India and it can be educated for the development of the country (Mohan Gautam, 2016). The employability of educated population increases with the skill set. The candidate may be under employment if lacks necessary knowledge and skill set (Nadar, 2018). The higher education system in India faces many challenges due to faculty shortage, poor curriculum, untrained staff etc. Hence state and central governments have taken many steps to improve educational quality (Anubhav, 2015).

In the laboratory, students follow standard laboratory protocol and perform experiments to meet the pre-determined outcome. The teaching and learning process in science and engineering education may be augmented with the laboratory classes. The laboratory classes help the students to understand the concept and hence play a key role in understanding the theoretical concept, collection and interpretation of data and report writing etc. Also students' observation capability, results and analyzing skills are improved. Hence it is suggested that the laboratory components may be introduced in each subject for better understanding (Lyle, et al., 2005). The development of innovative design oriented laboratory will engage the students in laboratory activities and students spend long time in the laboratory (Dunne & Ryan, 2010). This will enhance the students' learnability (Kirschner & Meester, 1988). The well maintained equipments, competent instructors and faculty members are essential for this (Edward, 1983). The learning of theory subjects may be improved with the help of laboratory experiments (Gian et al. 2018). The students get practical experience in the laboratory and also understand laboratory safety guidelines, safety labels, storage and handling of hazard materials (Romklao, 2012). Both the theoretical and experimental knowledge is important for the students (Lyle et al. 2005). The course syllabus and teaching methodology affects the learnability (Wallace & Kang, 2004). The prior knowledge on laboratory experiments and experimentation procedure help the students to understand the concept effectively (Julia & Kilian, 2016).

It is reported that the students face problems in understanding the content knowledge and instructions in the laboratory class (Ayse, et al. 2017). The qualitative research work carried out reveals the problems related to laboratory, staff members and fellow students (Özlem & Murat, 2013). The students will be motivated in learning process if the laboratory has latest laboratory equipments and instruments (Romanas et al. 2007). The students' learnability can be improved if they come prepared for the laboratory (Rodgers, et al., 2020). It is reported that the students lack team activities in the laboratory environment as they do not perceive team roles as a key parameter in success and productivity (Laura, et al. 2018). The students' critical thinking to perform the experiments and deep learning is low in the conventional teaching and learning process. One of the best methods in improving learning process of the students is virtual laboratories (VLs). The objective of this book chapter is discuss about VLs, types of VLs, review of success of VLs, advantages and limitations of the VLs.

BACKGROUND

The conventional teaching methods is teacher centered and in this method students are taught and learn through recitation techniques, memorization etc. The students demonstrate their knowledge based on the information absorbed in the class. The teachers adopt different techniques such as questioning, demonstrating, collaborating etc, which provide multiple learning styles to the students in understanding the subjects. However it is not developing students' problem solving, critical thinking and decision making skills. The e-learning is getting popularity in recent years and particularly in mathematics and engineering courses. The learners' knowledge can be tested based on their level of understanding (Gurudeo,

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