Chapter 56
Usage and Diffusion of Biotechnology Virtual Labs for Enhancing University Education in India's Urban and Rural Areas

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ABSTRACT

Information and Communication Technology (ICT)-enabled virtual laboratories provide an online learning experience with the aid of computer-based instructional materials (animation, simulation, and remote-trigger experiments) for improving the active learning process. The project reported on in this chapter was set up in order to enhance university and college education, which is now becoming an advanced training environment for solving the geographical, social, and economic challenges faced in the interdisciplinary field of science education, especially in India. In order to study the role of bio-technology virtual laboratories in the current education system, a pedagogical survey, via workshops and online feedback, was carried out among several student and teacher groups of different Indian universities. This chapter reports how virtual labs in biotechnology can be used to improve teaching and learning experiences in an easy and understandable way with user interaction and how such tools serve to effectively reduce the problems of laboratory education especially in remote areas. The results obtained from user-feedback analysis suggest the use of virtual labs as a recommended component in blended education in large classroom scenarios for enhancing autonomous learning process and as an alternative to enhance lab education in geographically remote and economically challenged institutes.

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INTRODUCTION

India has been constantly growing mobilization of resources and introducing new initiatives to improve accessibility and enhance education in the University sector in the last decades and progress has been made with considerable variations (see cases as in Clarke & Jha, 2006). To enhance University education in rural and urban areas several national mission projects had been launched in the recent years. It has been shown in literature that enrollment for education is not governed by government education policies but by household decision (Bersier, 2008) since they depend on task structure i.e. interpreting a decision based on user's inference or on preference. Based at a rural setting in South India, we experimented in enhancing biotechnology education through an ICT-based initiative.

Biotechnology education has become a growing field that led to new advances in many areas such as genetics, recombinant DNA technologies, developing new therapies and vaccines, food and agricultural industry, and other diagnostic studies. Laboratory experiences are vital components in teaching biology courses to apply the theoretical knowledge to practice (Diwakar et al., 2012; O'Donoghue et al., 2001). To revolutionize the problems in the current trend of education, virtual laboratories are becoming a new technology that have a promising role in supporting the education institutes by providing a new learning environment for users.

In the field of education, computer-aided technologies provide special advantages for designing innovative biology course materials and developing highly interactive student-teacher relationship (Hadjerrouit, 2010; Rajendran et al., 2010). Online education platform has grown tremendously as a supporting material in modern education scenario (Nam and Smith-Jackson, 2007; Flowers, 2011). In earlier days, conventional teaching was performed with lectures by teachers who followed a centered syllabus; students depended on textbooks to support their knowledge and an exam was conducted for an assessment criterion (Allen, 1998). But now the curriculum updates more frequently, seeking the help of internet technologies to advance the gain of knowledge (Bijlani et al., 2008). ICT in university education supports independent learning (Desai, 2010; Scanlon et al., 2002). Students following ICT-enabled blended education have been known to be advantaged with some social and knowledge skills such as tendency to solve problems, time management, communication skillset, group work where they can share information's, ideas between others which in turn boost up the quality of learning (Oliver, 2003; Tuysuz, 2010).

Also virtual lab techniques provide a medium for constructivist and creative learning (Shin, 2002) posing a motivation to student population. Over the last few years, computers have attracted widespread interest as teaching tool in the biological sciences (Laine et al., 2002). One of the other known frameworks, iLabs, developed by MIT provides online access to remote triggered laboratories thereby inducing users located anywhere in the world to have benefits of experiencing a hands-on practical session (Harward et al., 2008). From classroom-based board drawing to the computer-based graphics the effectiveness exerted by drawing skills on the understanding and memorizing capability of users (McClean et al., 2005) has been notable. 'The VITAL Lab (Virtual Immersive Technologies and Arts for Learning Laboratory)' developed by Ohio University provides online labs in many subjects including Environmental sciences. 'The Journal of Visualized Experiments, *JoVE* (http://www.jove.com/) which is mainly dedicated to biological sciences includes video and text based description of complex biological experiments and research protocols. Studying biological process by applying mathematics in virtual lab has attained large interest in these days, NASA's virtual laboratory or the Utah genetics virtual laboratories (http://learn.genetics.utah.edu/gslc) are good examples. 'The Virtual ChemLab Project', which simulates real