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Multi Disciplinary E Journal of Research

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Virtual Labs-A Technological Innovation in Science Experiments

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Abstract:

The aim of the Virtual Labs is to provide students access via the Internet to various experiments in control environment, which are situated in control laboratories at several educational Institutes. Government of India and Various Institutes, Colleges and Universities are currently developing the Virtual Lab as a network of remotely accessible laboratories in order to set up a prototype experimental environment. Students under consideration are usually located at geographically distributed location (e.g. at home) and have remote access to experiments. The Virtual Lab is based on a distance education concept due to the fact that certain students (e.g. professionals) may be interested in studying even at places which are far away from campus eliminating the necessity to be there in person. In the Virtual Lab they are able to gain some practice in control theory at their convenience thereby saving travel time and cost.

Key words-Virtual labs

Introduction

The education sector in India, has been witnessing a massive transformation recently with changing job landscape, technological disruptions, demand for quality education and the implementation of National Education Policy (NEP) 2020. The pandemic caused further shocks to the system with educational institutes forced to shut down during the lockdown period, and the transition of students and teachers to online teaching-learning. In India, around 250 million students were affected due to educational institutes closures at the onset of lockdown induced by COVID-19. The pandemic posed several challenges in educational institutes which included an expected rise in dropouts, learning losses, and increase in digital divide. The pandemic also called into question the readiness of the systems, including teachers to address such a crisis and sustainability of educational institutes. However, COVID-19 also acted as a catalyst for digital adoption in educational institutes.

The virtual labs-Concept

Virtual labs are an educational simulation environment that allows students to complete lab experiments online and explore concepts and theories without going into a real science lab. Students can experience lab techniques for the first time and become more familiar with advanced laboratory equipment that may be inaccessible because of its high price or because of its danger. Through animation, students can explore life sciences at the molecular level and look inside the machines they operate. Virtual laboratory software creates opportunities for alternative access to science education, and virtual sites are applications of virtual reality technology.

Need and importance of virtual labs in e-learning

Protect students while they deal with chemicals. Provides a realistic learning experience rather than having learners make assumptions or memorize concepts and procedures help to solve the problem of lack of capabilities in educational Institutes. To provide cooperation and interaction between students and each other, and between teachers and students also. Helps teachers evaluate students electronically. It helps students, especially in the early stages, to overcome boredom because of the theoretical sciences that they study in their educational Institutes.

It allows the student to do the experiment more than once, allowing him to fully absorb it. Virtual labs leave a wide field for experimentation and interaction between learners and teachers, and virtual labs provide an enjoyable scientific experience. So the Virtual Lab platform, provide a more interactive experience.

Science learning or science education is the teaching of science to non-scientists, such as school children, college students, and also adults within the general public.

The science learning field can include work in science content, science process (the scientific method), social and citizen science, and some teaching pedagogy.

Now days the Advances in computer and network technologies may facilitate and provide constructivist and cooperative learning environments, thus paving the way for cooperative activities and constructivist learning.

Objectives of Virtual Labs

1. To provide remote-access to simulation-based Labs in various disciplines of Science and Engineering.

2. To enthuse students to conduct experiments by arousing their curiosity. This would help them in learning basic and advanced concepts through remote experimentation.
3. To provide a complete Learning Management System around the Virtual Labs where the students/ teachers can avail the various tools for learning, including additional web-resources, video-lectures, animated demonstrations and self-evaluation

The Philosophy of Virtual Labs

Good lab facilities and updated lab experiments are critical for any educational institute. Well equipped lab facilities are necessary to conduct experiments. Also, good teachers are always a important resource. The Virtual Labs will addresses these issues of lack of good lab facilities, as well as trained teachers, by providing remote-access to simulation-based Labs in various disciplines of science and engineering. Along with it its student centered it will arouse the curiosity of the students and permit them to learn at their own pace. This student-centric approach facilitates the acquisition of basic and advanced concepts through simulation-based experimentation. Internet-based experimentation further permits use of additional web-resources, video-lectures, animated demonstrations and self-evaluation. Specifically,

- Access to online labs to those educational Institutes that faces lack of lab facilities.
- Access to online labs as a complementary facility to those educational Institutes that already have labs.

Virtual labs are any place, any pace, any-time, any-type labs. It is a paradigm shift in student-centric, online education.

Virtual Labs is a project initiated by the Ministry of Education, Government of India, under the National Mission on Education through Information and Communication Technology. The project aims to provide remote access to Laboratories in various disciplines of Science and Engineering for students at all levels from undergraduate to research.

Virtual Labs have been designed to provide remote access to labs in various disciplines of Science and Engineering. These Virtual Labs cater to students at the undergraduate level, postgraduate level as well as to research scholars. Virtual Labs enable the students to learn at their own pace and motivates them to conduct experiments. Virtual Labs also provide a complete learning management system where the students can avail various tools for learning, including

additional web resources, video lectures, animated demonstration, and self-evaluation. Virtual Labs can be used to complement physical labs.

Benefits of Virtual Lab for Science

The science learning goals of laboratory experiences include enhancing mastery of science subject matter, developing scientific reasoning abilities, increasing understanding of the complexity and ambiguity of empirical work, developing practical skills, increasing understanding of the nature of science, cultivating interest in science and science learning, and improving teamwork abilities.

The researchers suggest that laboratory experiences will be more likely to achieve these goals if:

- They are designed with clear learning outcomes in mind.
- They are thoughtfully sequenced into the flow of classroom science instruction.
- They integrate learning of science content and process.
- They incorporate ongoing student reflection and discussion.

Computer-based representations and simulations of natural phenomena and large scientific databases are more likely to be effective if they are integrated into a thoughtful sequence of classroom science instruction that also includes laboratory experiences.

Advantages of virtual lab in Science

- 1) Virtual labs enable students to perform many experiments that are difficult to perform in real laboratories because of the risks.
- 2) Virtual labs help teachers and students save time and effort because they don't need to adhere to certain times to enter the lab, or to move from one place to another.
- 3) Virtual labs enable students and teachers to use the latest technologies.
- 4) Virtual Labs help users keep up with the technological development of the digital age.
- 5) Virtual labs allow students to perform the practical experiments related to the theoretical courses, which helps them absorb the courses.
- 6) The virtual lab provides enjoyment during experiments.
- 7) Virtual labs help students perform the experiment more than once.
- 8) Virtual labs protect students and teachers from hazards, given there is no direct contact with toxic or radioactive chemicals and there is no handling of explosive devices or electricity.

- 9) Virtual labs provide the convenience of changing the inputs and transactions used in the experiment without worrying about any dangerous effects of these changes.
- 10) Virtual labs allow students to stay in touch with the Internet, which helps them search and gather information during the experiment.
- 11) Virtual Labs enable students to record results electronically and share them with others to exchange experiences.
- 12) Virtual Labs provide teachers with the opportunity to follow up and evaluate students electronically.
- 13) Virtual labs provide flexibility in performing experiments.
- 14) Virtual labs provide a complete Learning Management System (LMS) around the virtual labs where students can avail the various tools for learning including addition web-resources, videos, animated demonstrations and self-evaluation.

Disadvantages of Virtual Laboratory

- 1) They require computer devices with high specifications in order to simulate the exact phenomena with full details and create a three-dimensional virtual lab.
- 2) They require professional programmers with strong skills in different programming languages. They also require a team of experts in the scientific material, teachers, and experts in psychology.
- 3) One of the negative effects of Virtual Labs is that it reduces the direct interaction between students and each other, and between students and teachers, given that the communication between them is electronically most of the time.
- 4) Due to the experiment in virtual lab can repeat as many times as necessary, student will get insensitive to failure and danger in a real situation.
- 5) Students can learn something useful from a full sensory experience in a real lab like weird noise and smell, random error, faulty machinery, etc.

Conclusion

Virtual labs are one of the technological innovations among the modern educational methods. In virtual labs, the computer is used to provide a 3D virtual environment for the science lab. Virtual lab will be helpful to teacher during this pandemic. teachers respond and strive to provide quality education for their students. Sciences should be learned through minds-on and

hands-on, hence teachers must be able to create virtual classroom conditions that help students maintain learning momentum while they cannot interact each other physically. Also using the internet and computer student will be able to complete their experiments in real time. Besides this, the student will be able to access information in various materials and disciplines, which develops his skills and helps him to keep abreast of daily developments in the field of education.

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