

The role of Virtual Laboratories in Science Education

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Abstract: Information technology has provided new innovations to sustain constructing an artificial educational environment by means of computers. Certain artificial environments sometimes go beyond natural environments, such as simulations and virtual reality, which is a sophisticated educational technology emerging for less than a decade (Hamit, 1993). Virtual reality is distinguished by unique sorts of interaction, that responds to users' behaviors and actions. Unlike traditional multi-media, virtual reality offers a distinctive level of interaction. Hence, virtual reality is considered to be a new model of computer-based learning, that provides the individual learner with a wider range of scientific vision (Chow & Andrews, 2007). This kind of educational technology provides an advanced individualized learning perfectly meets the educational needs and provides a high level of flexibility and freedom from constraints of time and place (Barbour & Reeves, 2009). One of the most important features of virtual reality is the easily and continuous material update aiming to attain learning objectivity and interest (Al-Shanak & Doumi, 2009).

With the increasing popularity of virtual educational technology, globally and locally, the development of virtual learning environment became an important field of science which has its own basics and principles. On observing the reality of science education in Arab region today, the learner is constrained to the theoretical method in acquiring knowledge, rarely allowed to apply these knowledge practically. This is due to several reasons including; the lack of laboratory devices, the risks that may result from applying some scientific experiments, and the high cost of materials (Al-Raid, 2008).

The above display demonstrates the need to apply virtual learning environment in teaching science. The current paper will tackle this issue, highlighting the following themes:

- What is meant by: virtual reality, virtual environment, and virtual learning?
- What are the characteristics and features of virtual learning systems?
- What are the characteristics and possibilities of virtual learning environment of science?
- What is a virtual lab?
- Why the need arises to virtual labs?

The importance of the paper:

The importance of the current study is demonstrated in its relevance and advantage to various aspects of educational process, which could be stated as follows:

- The current paper contributes to present definitions to the following terms: (virtual reality, virtual education, virtual laboratory, virtual instructor).
- Investigates the importance of scientific virtual environment.
- Presents recommendations and suggestions.

Keywords: virtual reality, virtual laboratory, science education, E-learning.

1. Introduction

During the last decades, the information and communication technology has witnessed a rapid development in all fields. The resources of knowledge became various and numerous. The course of science is obviously connected with technology, both cognitively and practically. Yet, 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

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cost, or lack of time to complete the experiment. Furthermore, it will help the student in investigation and searching, which are considered the main aims of teaching science. (Al-Shaie 2006, P.2. Dillon, 2007).

The fields of internet-based learning are diverse, including virtual laboratories of science, which are considered the main underpinning in practical electronic learning, seeing that virtual labs closely resemble real labs (Al-Baiati, 2006, 13, Salamah, 2007,11).

Moreover, a technology-enriched environment would greatly enhance students' motivation and develop positive attitude towards the course. Subsequently, the academic achievement would be enhanced. Several studies emphasized the vital role of virtual labs in developing academic achievement, providing awareness of scientific concepts, and modifying misconceptions. For example, (AlSharhan, 2009, Lal and Al-Gindi, 2009, Hartinez 2003).

So, this paper aims at discussing the modern technology of virtual laboratory, as a model of E-learning and its role in teaching science. This paper will discuss the following:-

- The concept of virtual lab.
- The components of virtual lab.
- The characteristics of virtual lab.
- Virtual labs constrains.

2. Virtual Lab Concept

It was defined as "laboratory experiment without real laboratory with its walls and doors. It enables the learner to link between the theoretical aspect and the practical one, without papers and pens. It is electronically programmed in computer in order to simulate the real experiments inside the real laboratories." Harry & Edward, 2005).

In addition, it was defined as "A virtual studying and learning environment aims at developing the lab skills of students. This environment is located on one of the internet pages. Usually, this page has main page & many links, which are related to laboratory activities & its achievements (Zaitoon, 2005, 65).

Through the above mentioned definitions, the virtual lab can be defined as virtual studying and learning environment that stimulates the real lab. It provides the students with tools, materials and lab sets on computer in order to perform experiments subjectively or within a group at anywhere and anytime. These experiments are saved on CDS or on web site.

3. The Components of Virtual Lab

The main components of the virtual labs are determined to have the following: (Al-Baiati, 2006 M, 28-32, Dillon, 2007).

1- The lab sets & equipments

The virtual lab is considered integral to the traditional lab but not an alternative to it. The existence of the traditional lab is very necessary, but in lower numbers and requirements, which help in the possibility of using it by several users outside the lab.

2- Computer devices.

They are represented in personal computers, which are linked to the local net or to the international net so that the student can work directly in the lab, or distantly at anywhere and anytime.

3- Communication network & the related hardware.

In case of performing experiments electronically, all the sets should be linked to the computer, because the link between the users with lab will be through digital communication.

4- The Programs of the Virtual Lab:-

These programs are represented in the simulation programs, which are designed by professionals. It is necessary to design this program in an interesting and attractive form; as these programs were designed to attract students' attentions and urge them to complete the experiment. This is maintained by the animation techniques, video, and the three dimensions pictures.

5- Co-operation Programs & Management.

These programs are concerned with the method of managing the lab and the ones who perform the experiment, including students and researchers. These special programs register students in the lab program and determine the kinds of access that should be provided to each user in the different experiments.

6- Technical Staff.

It is important to have a technical team to support educators in preparing and assessing scientific materials. In addition to evaluating the program to determine its efficacy.

4. The Characteristics of Education in Virtual Lab

Professionals confirmed certain characteristics of the virtual lab. They are as follow; (Harry and Edward, 2005- Zaitoon 2005- Carnevale, 2003).

- Creating new intellectual model in education better than the real, and more beautiful than the imagination.
- Knowledge-building and inculcate information.
- Encouraging and guiding students.
- Registering students' information and evaluating them automatically.
- Performing experiments, which are difficult to be performed in the traditional lab due to its danger and high cost.
- Reducing the learning time spent in the traditional lab.
- Develop an exploration based on scientific assumptions and processes.
- Permanently updated.

5. Virtual lab constrains

Among the impediments to the virtual lab are :- (Canevale, 2003,2) (Zaitoun 2005,166)

- The scarcity of the virtual labs, which rely on Arabic language.
- The lack of real interaction between hardware, tools, instructors & colleagues.
- The need for computers and tolls with special standards.
- The need for specialized working staff, instructors and curriculum experts for designing and production.
- The lack of lab social skills gained in the virtual lab compared to the real lab.

5.1 The Characteristics of Education in consideration of School Lab & Virtual Lab:

Educators made a comparison between the school's lab & virtual lab. The researcher recorded it in the following table (Lal, Zakaria, Al-Jindi, Aliaa, 2005, Abdul Aziz, 2008, Al-Zharani, 2008).

Table 1: the characteristics of education in consideration of school lab & Virtual lab.

No	Characteristics of education in consideration of School's Lab	Characteristics of education in consideration of Virtual Labs
1	Closed educational environment	Flexible & opened educational environments.
2	The book & the teacher are the main sources of knowledge	Education depends on varied resources & multimedia.
3	Separating between the theoretical & practical, and between the real & imagination	The integral between the theoretical & practical aspect in virtual situations that stimulates reality.
4	The standardized official education	Continuous learning lifetime
5	Teaching the whole class in large group.	Teaching the whole class through small or individual groups.
6	The traditional method	Varied methods of teaching
7	The individual differences are not considered	The individual differences are considered
8	The teacher positivism, but negativism of the learner.	Positive and active participation from both instructor and learner.
9	Verbal teaching methods	Varied teaching & learning methods.

5.2 The Relationship between Virtual Labs & Electronic Education

(Al-Baiati 2006,13) assures that the virtual labs are considered to be the main support in electronic learning in the scientific & applied field. This is through using different electronic programs that simulate the experiments on computer by using different pictures and drawings, which express the experiment to be performed.

(Al-Shehri 2009, P.56) mentioned that the electronic learning is the umbrella term, under which the virtual lab are lying.

Thus, there are three types of electronic learning in consideration of virtual labs; (Zaitoun,2005,163) (AL Shaie, 2006,443) (Martinez, 2003).

- 1- Synchronous electronic learning through the virtual lab.
- 2- Asynchronous electronic learning through the virtual lab.
- 3- The intermixed or programmed learning through the virtual lab.

6. Some of the Related Studies that Handled The Virtual Lab Concept

- (Al-Shehri, 2009), which showed the positive effect of using the virtual labs on providing the student with the laboratory experiment skills in the biology course of 3rd secondary school students, in Jeddah.
- (Al-Mahmadi, 2008), which showed the effectiveness of the virtual lab in developing the academic achievement of the female students of 2nd secondary grade, in chemistry.
- (Sebas Tinanfotis and Gal Ring, 2008). The project aimed at using learning environment depends on electronic virtual labs in order to support the learning process in the academic achievement of science course intermediate school. The study has revealed that using virtual labs encourage to modify the wrong concepts.
- (Tracey, 2007). This study aimed at studying students' opinions, at the University of Northern Illinois, U.S.A, concerning the virtual biological labs. It revealed that 86,9% of the students support the virtual labs.

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