



## “Web-Based Virtual Learning Environment”: A Preliminary Assessment Of Effectiveness Of Virtual Science Activity On Conceptual Understanding

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Article History	Abstract
Received: 18 June 2023 Revised: 12 Sept 2023 Accepted: 10 Oct 2023	<i>The present study aimed at examining the effectiveness of the web - based virtual activities on the development of student’s conceptual understanding in science. The effect of virtual activity was evaluated in term of learning gains and perception. To achieve these objectives an experimental design is selected. Since application of the result to conventional lab activity of selected concepts of science was one of the prime concerns to the researches, the activities were conducted in convention physics lab as well Web-based Virtual OLABS. The study found that virtual science activity is more effective on conceptual understanding.</i>
CC License CC-BY-NC-SA 4.0	<b>Keyword’s:</b> Virtual Activity, Conventional Lab Activity and Conceptual Understanding

### 1. Introduction

#### Rationale

After paradigm shift in teaching learning process after and during pandemic -19 learning is not limited not only the boundaries of face-to-face classroom. While introducing the National Education Policy 2020 (NEP-20) of India the practice of innovation and learner centric approaches are increased. Science learning in the laboratory is intended to provide experience in the handling of real objects, which is also thought to help learner in their conceptual development. It is very difficult to think of learning to do Science or leaning about science, without involving lab activities or work.

#### Conceptual Understanding through Science Activities

Science Activities are excellent mode for teaching and learning Science. They provide students opportunities to reflect about, discuss, and resolve their real time problems and decision making. The conventional goals of the introductory Science activities are useful for development of: -

- Problem Solving Skills
- Decision Making Skills
- Analytical Skills
- Higher Order Thinking Skills
- Conceptual Understanding
- Collaborative Learning

Science learning through activity initially utilize these basic activities as the foundation for developing more complex movements required in subsequent experiments. In addition, lab is not thought to be a place where students can learn theory of science learning but a place for developing Science process skills, which are built over on concrete development of science process skills. An important objective of Science learning is the gaining of Science Process Skills with the help of concepts. It is argued that good Science Process Skills can be achieved through a mastery of conceptual understanding. It is also claimed that a common cause of failure in problem solving in the Science learning is the lack of conceptual understanding and deeper insight into the consequences of principle (Herron, 1996). A well-designed Science learning activities can provide the sorts of

experiences necessary to correct misconceptions and to develop useful physical insight. It is one of the few places where students can actually involve themselves in the processes of science learning: students gain first-hand understanding of phenomena of science, construct for themselves the theories needed to comprehend the real world and express their own questions, further engaging them in the Science process skills. In Science, development of students' conceptual understanding has very important significance.

When we say that we understand something, we mean that we know when it happens or exists, why it occurs in a certain way, and in which direction it probably will develop (B. Manisha 2014). Thus, conceptual understanding means much more than knowing the facts and imitating the process. Especially when Science is concerned, understanding includes, functional and procedural understanding, among which conceptual understanding is critical.

“Concepts are defined as classes of objects, symbols and events that are grouped together in some fashion by shared characteristics”. Referring to this definition or description of concepts, one may think that development of concepts is to learn certain words or phrases, and including to which objects or events they refer, which attributes these objects have in common, and whether one object belongs to the concept class or not. It is imperative to know that concepts find their meanings within a theoretical context. For instance, the concept of solution is better understood in the context of establishing the relationship between a solvent and solute. Students who are able to solve numerical problems are not necessarily able to solve conceptual problems. Students have been found to rely more on algorithmic techniques rather than reasoning skills. For example, students may be able to solve numerical problems dealing with gas laws but are unable to solve conceptual problems on the same topic when problems are presented in the form of a diagram (Savander-Ranne & Kolari, 2003). Students who are able to solve stoichiometric problems may have serious difficulties in understanding a diagram-based performance on the combination of concepts. The conceptual understanding enables the students to grasp similarities and differences, which he/she would otherwise have great difficulty coping with. Development of conceptual understanding helps in:-

- cognitive learning.
- Identifying, facts, objects of the world
- Decreasing the necessity of content learning
- Providing direction for instrumental activity
- Making instruction possible

By development of concepts, explains that students build the learned concepts into their cognitive structure and build up a consistent conceptual framework. This conceptual framework is required by students to develop the higher order thinking skills that enable them to use and apply their learning in a meaningful way (Javidi, 2005). An instructional practice that has emerged over the last two decades began with what is commonly termed the web-based virtual approach of learning, in teaching of science learning. Improving activities has become a priority in many institutions. Science learning is taught in general as a bundle of abstractions without practical experiences. This has resulted to students' low acquisition of Science Process Skills which has become more evident in the mass failure of conceptual understanding in science learning. Science Process Skills are relevant and appropriate for all Science subjects, in particular Science learning at the senior secondary schools.

Web-based learning environment has offered tools for active learning. It represents its capacity to create new opportunities for solving problem and different learning styles. Furthermore, technology not only help students create an active learning environment to solve problems but also help them in finding their own problems. Online Web-based Virtual Learning are interactive, it is now easier to create active environment in which students can learn by doing in receiving feedback, and immediately refine their conceptual understanding and build new knowledge. It can also very useful to visualize difficult to understand concept which are difficult to state verbally (Linn et al., 1996). Concisely, Web-based Virtual Learning are used as a tool to enhance student's educational experience by creating a variety of methods to meet special needs, teach children how to manage information and allow for opportunities to develop higher level thinking skills. This approach leads the occurrence of new paradigm in teaching and learning. One of the most effective alternative solutions of above for science learning education is Virtual Science activities. This approach goes beyond current interactive simulations where students may manipulate variables but independent decision-making is constrained. The central idea of Science Learning Web-based Virtual activity is the implementation of a laboratory environment

that offers students all the attendant manipulative features, ability to make mistakes and measurement errors where the conditions are very similar to those realized in convention laboratories.

Hence, there is need to find out the level of acquisition of the process skills, and influence of gender and class size, since process skills are very fundamental to science and there exists a serious educational gap in this area in bringing these skills into the classroom.

### Web-Based Virtual Learning

Web-based Virtual Learning is one of the important designs currently being used frequently. Different experts of the area defined Web-based Virtual Learning differently. Below are given some important definitions- According to Wiseman, Wong and Wolf (2008). a Web-based Virtual Learning is facility where students can access convention lab similar equipment by computer.” However new technologies have furthered the above statement and have enabled the manipulation not only of real-world equipment but of its virtualized analogies as well, which gives a more specialized meaning of the term ‘Web-based Virtual Learning.

Omar, Zulkifli & Hassan (2009). Web-based Virtual Learning combine technology resources, reusable software environments, and automation, along with tried-and-true training concepts, to enable hands-on training that can be delivered to anyone, anywhere, any time. Ozkurt & Guzel (2010). Web-based Virtual Learning is a computer lab a computer program that allows student to run simulated experiments via the web or as a stand –alone application.

### 2. Methodology

It is well known fact that every individual student is a different personality. Every student has different social as well as family background, experience, knowledge, skills language proficiency, IQ, interest, and learning styles. Every student perceives and learns the same content differently. So, for development of tests and selection of virtual activity catering to the learning needs of all the students, a need was felt to identify the topics which most of the students feel difficult to develop concepts.

Sample of the study consisted 250 students of 11 standard of different CBSE and State Government schools of MP. These colleges were identified looking to the availability of well-equipped physics lab and willingness of management and staff. The present study seeks to investigate the effectiveness of virtual activity with respect to convention lab of developing concepts in science learning. As the present study is experimental research, to study the effectiveness of developing concepts in Science through Web-based Virtual Learning a need was felt to selection of Web-based Virtual Learning activities and software on the identify topics from science curriculum. In present study researchers have identified OLABS for this study. The OLabs hosts experiments in Physical, Chemical and Biological sciences for the students from classes 9 to 12 with content aligned to NCERT/CBSE and State Board Syllabus of India.



**Fig-1.1** A screen Captured of OLABS

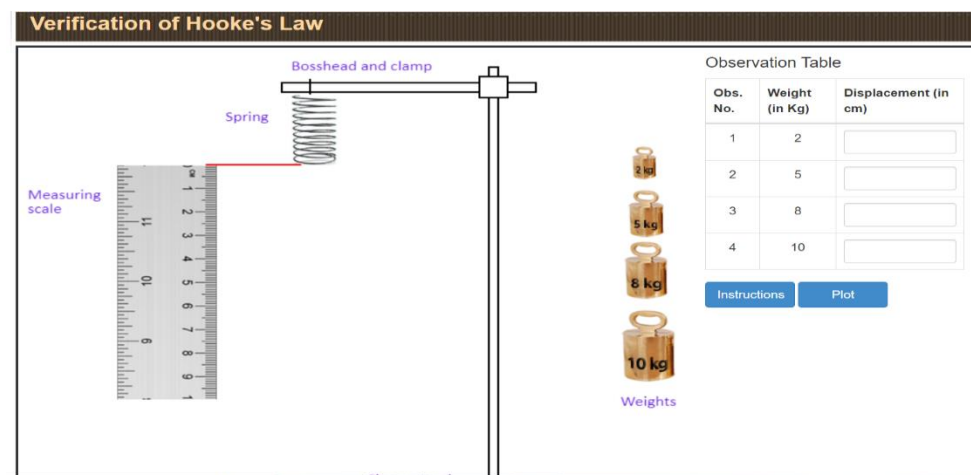
Energy is the basic topic of science but their application and conservation of energy are not so easy to grasp. Hooke’s law is the most important energy transformation concept which can only be defined in term of other concepts (stress & stain, types of energy), abstract properties and mathematical relationship. The virtual laboratory allows students to change stiffness and length of spring according to requirement, change in parameter, number of oscillations, matter of spring and conservation of energy to verified Hook’s law in term of conceptual development. Finally, in present study researchers have considered **Hooke’s law with the help of spring oscillation through virtual activity**.

The experiment of identified topics was divided into three concepts and one principle. Detail classification of concepts and principles shown in Table-1.2.

**Table-1.2** Content analysis of the selected concepts and principles

S.NO.	Activity	Principle	Concept
1.	Verification of Hooke’s law	1. relationship between stress and stain	1.spring constant 2.stiffness of spring 3.conservaion of energy

Based on detailed content analysis of the selected concepts and principles of physics as shown in table-1.2 was done. The concept map shows interconnectivity of concepts and principles in one activity. These concept mapping facilitated to conceptual development through conventional mode as well as selection of virtual activities. The present study seeks to investigate the effectiveness of conceptual development through virtual science activity. This would require not only for measuring the achievement after treatment but also measuring entry level knowledge before treatment. In the study one treatment was given separately, virtual activity treatment to the experimental groups & conventional physics lab activity treatment to the control groups.



**Fig - 1.3** A screen Captured of Virtual Activity through OLABS

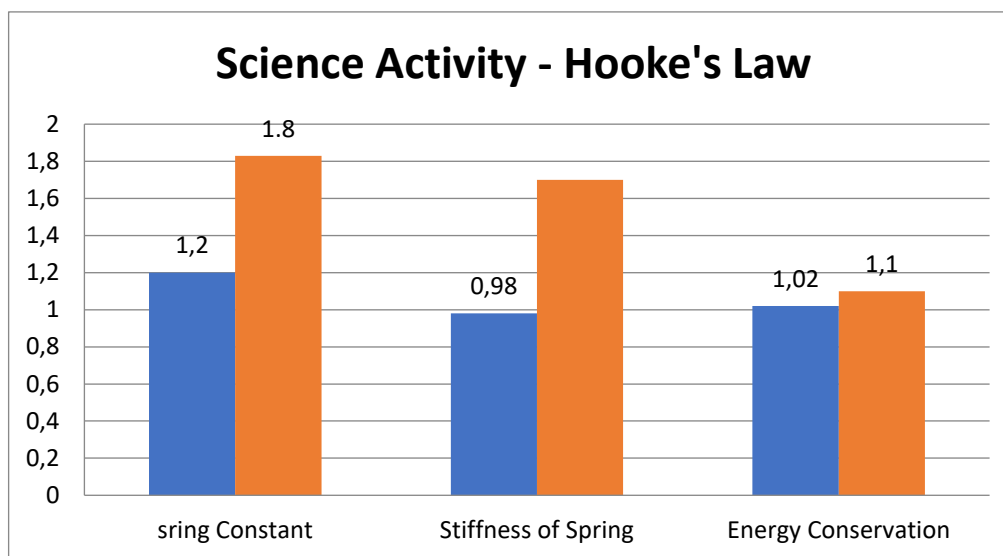
A web-based virtual science activity was used for experimental treatment and a conventional physics lab same activity was used for control group treatment. Therefore, Pre-Test and post treatment achievement test (Post-Test) were developed for this study Test were used for control and experimental group.

**Table-1.3** Specification Table with Weightage Assigned to Objectives & Item Distribution

s.no.	Experiment	Principle	Concept	No. of item as per specific objectives			Total item
				knowledge	understanding	application	
1.	Verification of Hook’s law		1.spring constant	02	03	03	08

1. relationship between stress and strain	2. stiffness of spring	02	03	03	08
	3. conservation of energy	03	03	03	09

**Inference & Discussion** - The graph 1.4 shows that achievement gain of student in term of developing isolated identified concepts (spring constant, stiffness of spring and conservation of energy) of the **Hooke’s law** through virtual science activity is higher compared to Conventional lab activity.



**Graph -1.4** The Achievement Gain of Two Group’s on Conceptual Understanding of Activity of Hooke’s Law Through Virtual Science Activity and Conventional Lab Activity

The analysis shows that virtual science activity helps the student in develop above three concepts related to the Hooke’s law better than the conventional lab activity. The study found that virtual science activity is more effective on conceptual understanding i.e. spring constant, stiffness of spring and conservation of energy related to the **Hooke’s law**”.

The analysis of data described in objective and inferences of above shows that there is significant difference between mean achievement gain of learners develop identified concepts and principles of physics. The study shows that web – based virtual science activity is more effective for conceptual understanding in physics then conventional lab activities. These findings indicate that virtual activities have significant effective on conceptual understanding of physics with respect to conventional lab activities. This study also revealed that many students with relatively new conceptual and experiential contexts, but students were able to engage on a conceptual level. Web- based Learning activities have a great potential to get science learning to masses. It is time that educators come to the fore front to get such web-based activities in place.

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