Collaborative Learning Through Virtual Labs in Engineering Education

Sunil Kumar Jakkula¹, Purushotham Endla², Praveena Dugyala³, T.Kumaraswamy⁴

¹,²,³Department of Chemistry, SR University, Warangal-506371, Telangana, India
¹,²,³Department of Humanities and Sciences, S R Engineering College, Warangal-506371, Telangana, India
⁴Sumathi Reddy Institute of Technology for Women, Warangal, India.

Email : suneelsrec@gmail.com

Abstract. In education, virtual laboratories are a novel screening technique. Such virtual laboratories assume a critical job in the field of moulding engineering. There are different applications in the instruction arena where the use is traditional. This paper plans to captivate the engineering feat with the bang of a virtual laboratory in the design of teaching. In the course, entitled 'Engineering Chemistry' the fundamental point of this thesis is to investigate the effect of a virtual science laboratory on engineering deeds. It introduces the planned electronic assets for a virtual lab and explains the e-asset implementation strategy. Later, by comparability with the routine in class contexts, the work reviews the usefulness of virtual science laboratories connected with engineering education, research skills and practice. The examinations specify that the traditional style of combining both virtual and hands-on learning circumstances is likely to help the potential and practice of engineering research in structural science.

1. Introduction

In today's world, the practice of information technology is extremely rapid. Information technology technologies are huge and increasing every day. In all fields of secondary and higher education, plus engineering, this information is used. Technology implementation will alleviate more concentrated and question-based learning for students. The Flipped classroom is a replica of the subject outside the classroom and its impact in the classroom (1). Recent learning pedagogy [2] has been largely affected by the rise in web-based education. The establishment of computer-based education has brought a reflective improvement during virtual laboratories in engineering torrent. In all subject areas, and especially in science, virtual laboratories are available, particularly in the field of chemistry. The virtual chemistry laboratories concentrate on new aspects of engineering classroom education. Such virtual laboratories are stretchy, reducing time and learning gaps.

During simulation processes, students undergo a peculiar activity that allows them to relate to laboratory experiments. Digital laboratories minimize errors, such as when trading with instruments or when experimenting. At present, a lot of computer software is taught with a new course in the
engineering chemistry laboratory that in turn improves relationships with student teachers. Web-based education is a distinct pedagogy, and it needs few qualities to fiddle with. This differs in style, enabling the integration of web-based education by various educational institutions [5].

A main element of engineering learning is the engineering chemistry laboratory course. A particular overview of new learning is laboratory work. Skills in education are critical and are especially noteworthy in the field of science education [6].

In order to do this, one must discuss the design of the experimental experiment, which is then challenged by faculty and students. Learning will boom if the three areas of learning, i.e. cognitive, emotional and psychomotor [7 and 8], are rationalized. Digital laboratories have a distinct environment of learning, which seems to be accompanied by essential learning. In many ways, it is gaining a reputation [9].

Visualization techniques used in virtual labs encourage students to try to learn science in a fun way through an open-minded experience in the virtual world [10]. In virtual laboratory education, all obstacles that occur in the management of conventional laboratory experiments are separated [11].

Students reinforce their understanding of fine molecular level change and achieve better conceptual learning (12). Students are finally becoming more optimistic about using computers for learning. They find simulation lab tasks exciting and therefore produce a lot of practice. Simulation of learners in the performance of cognitive tasks and the growth of their learning practice [13].

The essence of this research is to launch the outcome of a virtual chemistry laboratory in the course entitled 'Engineering Chemistry' on student achievement. The aims of this are as follows: it provides electronic tools for a virtual laboratory and explains a way of implementing e-resource. Afterwards, through a similarity with the normal in class style, the work tests the performance of the virtual chemistry lab attached to cute student science education, research abilities and practice [14,15].

2 Methods
2.1. Determination of Fe$^{+2}$ in Mohr’s salt by potentiometry

Find out the percentage of Fe$^{+2}$ ions in Mohr’s salt with the K2Cr2O7 solution by means of potentiometry. Students learn the basic concepts of potentiometry and build how to do and process test data by notifying themselves of the system. Students study physical planning properties; understand
what effect $\text{Cr}_2\text{O}_7^{2-}$ ions have on $\text{Fe}^{2+}$ ions and how to achieve the endpoint. Students explain how to exercise and track the examination system in the virtual chemistry lab. Starting with several realistic examples, students choose a point of study and direct tests to illustrate valid elixir science. They terminate the lab at that stage, process the data, and draw a differential graph in Microsoft Office Excel. Students review the effects of the acquisition and finish it. Finally, with all the numbers, students pile up a statement. The virtual creation is completed with the test, which makes it possible to determine whether learning will guide a real experiment.

2.2 Plan of the experiment

A total of 60 students will take part in the exam. Members divide the exploratory squad into two squads ($n = 30$) and supervise the squad ($n = 30$) according to their roll numbers. The test squad controlled the teacher with a virtual laboratory learning situation frame where students had the ability to conduct, question, run the virtual science laboratory prior to in-class trial work. Both students voted to engage in the practice of review and evaluation. Students were thrilled to see their success and get interested in their proceedings. Show and hands on convention were accompanied by a lot of study to test the elasticity of the students in their learning educational plot using virtual labs. The additional analysis (table 1) with scale evaluation (1-Poor, 2-Average, 3-Good, 4-Very Good and 5-Excellent) was integrated into the critique study (table 2).

| Sl No. | Questions for analysis                                                                 |
|-------|----------------------------------------------------------------------------------------|
| Q1    | How you pace the online presentation of the experiment?                                 |
| Q2    | To what level did you have managed over the interactions?                                |
| Q3    | Actual lab atmosphere simulated to what scale?                                          |
| Q4    | Measurement and data study was prepared to be easy or not.                              |
| Q5    | Lab manuals were set up to be helpful or not?                                           |
| Q6    | Internets links provide were consistent with that of experiment.                        |
| Q7    | Were the results interpretable with no difficulty?                                      |
| Q8    | A clear perceptive of the experiment gained or not?                                     |

Table 1. Analysis on virtual labs adaptability in classroom teaching.

| S.No | Questions for analysis |
|------|------------------------|
| 1    | Name the primary standard solution used in the standardization of $\text{K}_2\text{Cr}_2\text{O}_7$ solution? |
| 2    | Name the buffer used in calibration of the potentiometer?                                 |
| 3    | Name the two electrodes used in potentiometry?                                           |
| 4    | Name the critical step involved in the end point determination?                          |
| 5    | What is the color observed for sample in beaker at endpoint?                             |
| 6    | Write the basic principle of Redox titration?                                           |
| 7    | How do you determine the endpoint in potentiometry?                                     |
| 8    | What is the effect of temperature on potentials of ions?                                 |
What is meant by differential graph?

What formula is used in determining the strength of reducing agent in Potentiometry?

The response of students were specified in percentage scales and plotted.

2.3. Results

Feedback data from students was obtained from the virtual lab. It was used in their learning process to test the basic execution of virtual laboratories for use. Approximately 60-65 percent of engineering is measured by virtual laboratories as a specific learning offer that performs training in their science testing facility. Digital laboratories are efficiently scalable instruments for engineering to advance their ability to learn and thereby reduce standard deficiencies during the learn in the wet labs (see figure 2). Shortly, the data chopped by measuring the overall performance of the customer based on the marks came from assessment and soon tainted over to the percentage scale. The basic level of marks was calculated and discussed in a Pie diagram by the number of students scored (see figure 2).

Table 3. Analysis on the students overall performance when using virtual labs

| S.No | Question No | Experimental group | Manage group | Poor | Average | Good | Very good | Excellent |
|------|-------------|---------------------|--------------|------|---------|------|-----------|-----------|
| 1    | 1           | 25                  | 20           |      |         | 45   |           |           |
|      |             | 20                  | 28           |      |         | 48   |           |           |
| 2    | 2           | 30                  | 30           |      |         | 60   |           |           |
| 3    | 3           | 12                  | 18           | 28   |         |      |           |           |
| 4    | 4           | 10                  | 25           |      |         | 35   |           |           |
| 5    | 5           | 14                  | 20           |      |         | 34   |           |           |
| 6    | 6           | 10                  | 15           | 25   |         |      |           |           |
| 7    | 7           | 5                   | 10           | 15   |         |      |           |           |
| 8    | 8           | 5                   | 8            | 13   |         |      |           |           |
| 9    | 9           | 8                   | 12           | 20   |         |      |           |           |
| 10   | 10          |                     |              |      |         |      |           |           |

Figure 2. Feedback data of students with rating scales.
Above dimensions (figure 2) shows 60 students who scored incredible assessment for Q3, 48 students generally excellent for Q2, 45 students useful for Q1, 28 students normal for Q4, 35 students useful for Q5, 34 students useful for Q6, 25 students normal for Q7, 15 students poor for Q8, 13 students poor for Q9 and 20 students normal for Q10.

3. Conclusion
Since the main point of the current research was to put up the bash of a virtual science laboratory in the achievement of the engineering chemistry course. The pulsating learning approach has been expanded by virtual laboratories and it has been thoroughly dissected. The students are assisted by virtual laboratories to grasp the ideas of the trial. The findings undoubtedly illustrate the importance of the virtual laboratory, the study recommends virtual laboratories as an increasingly more feasible learning material, and practice by evaluation swears a better appearance. By starting a virtual lab, studies will keep away from normal blunders. The analysis of virtual laboratories is easy to use and reliable in allowing engineering to carefully pick up scientific theories, standards and systems.

Late evaluation of the combination of virtual laboratories in the construction of educational curriculum indicates that it has a stronger impact than its precious components in teaching excellent. The principle of testing even without a teacher is understood as a valuable learning material. Our analysis confidently reinforces that virtual laboratories provide a possible response for a fraction of the problem familiar with the regular study corridor test capability setting, and was helpful in improving the application of engineering in teaching in this approach.

The addition of virtual and physical testing laboratories proposes a preference for efficient achievement of learning objectives. This study may suggest further analysis of the use of virtual laboratories in the provision of science subjects in teaching design.

4. References
[1] Anuradha P 2019 The teaching learning process International Journal of Advanced Science and Technology 28 704-14
[2] Goverdhan C, Santhosh D, Katayani S, Shailaja S and Mahesh D 2018 A Study on the significant difference between the students of general category and reserved category in their achievement in english Indian Journal of Public Health Research & Development 9 211-16
[3] Ahmed S M, Madhuri G, Reddy M S and Condoor S S 2018 Skill development in freshmen
by adopting project based learning Journal of Engineering Education Transformations13 28-32

[4] Santhosh D, Goverdhan C, Shailaja S and Roopa G 2018 Impact of english language teaching in technical education Indian Journal of Public Health Research & Development 9(11) 242-47

[5] Hardman E and Smith S W 1999 Promoting Positive Interactions in the Classroom Intervention in School & Clinic 34 178-201 http://dx.doi.org/10.1177/105345129903400311

[6] Shailaja S 2018 Enhanced Innovative Techniques of ELT International Journal of Pure and Applied Mathematics 120 (6) 148-54

[7] Srinivas S and Soumya P 2015 A Traditional Novel Approach for Skill Enhancement of Teaching Learning Process in Engineering Education Journal of Engineering Education Transformations 28(4) 92-5 doi: 10.16920/jeet/2015/v28i4/70407

[8] Alok G, Anushalini T and Condoor S 2018 Effective Approach Towards Development Of Idea Through Foundation To Product Design Journal of engineering education transformation 31(3) 47-52 doi: 10.16920/jeet/2018/v31i3/120756

[9] Kumar K S, Alok G, Reddy M S and Reddy N B S 2018 An integrated Multi disciplinary Skill development strategy for effective execution from virtuality to reality in Engineering Education IEEE 6th International Conference on MOOCs, Innovation and Technology in Education 79-83

[10] Dziabenk O and Garcia-Zubia J 2013 Remote Experiments

[11] Hirsch J.E.2005 National Academy of Sciences 102 (46) 16569-72

[12] Chen S 2010 Computers & Education 55 (3) 1123-30

[13] Kostras N, Xenos M and Skodras A 2011 IEEE 54 (2) 308-13

[14] De Jong T, Liun M C and Zacharia Z C 2013 Science 340 305-8

[15] Huba M and Simunek M 2007 IEEE 54 3112-21

Acknowledgement
The author wishes to thank anonymous support given by SR University, Ananthasagar, Warangal Urban, Telangana, India-506 317.