



## EFFECTIVENESS OF E-LEARNING IN TEACHING CHEMISTRY WITH REFERENCE TO CERTAIN SELECTED VARIABLES

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### ABSTRACT

*The advent of Internet connecting personal computers and mobile devices has made a incredible development in the field of education. The web as a communications medium contributed for the growth of online learning and individual independent learning ambience. It provide a plethora of learning material with interactivity. At this stage the technologies, tools, techniques, methodologies and standards are advancing at a rapid pace wherein the educationists has to familiarize themselves with online learning or E learning. They have to identify or explore the best methods to be used for any given audience. E-Learning the new trend learning of gaining momentum at various levels of learning. Under such circumstances this study aims at finding the effectiveness of e-learning in teaching chemistry at higher secondary level in relation to certain selected variables identified by the researcher. The findings reveal that the students usage of computer and usage of internet have a better achievement than the other students who are not using the computer and internet frequently. The findings prompt that the higher secondary students should be made familiar to use the computer as well as to use internet s for their learning purpose.*

**Keywords:** E-learning, achievement, ICT, Chemistry, Internet

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### INTRODUCTION

Educators must go beyond computer literacy to achieve technological competence in successful integration of technology into the classroom is to occur. Technological competence also requires a transition from using the computer as an instructional delivery system to one of using the computer as a learning tool. (Deborah *et al.*, 1998). The trend of using E-learning as a learning and/or teaching tool is now rapidly expanding into education. E-learning is the new wave in learning strategy. Through innovative use of modern technology, E-learning not only

revolutionizes education and makes it more accessible, it also brings formidable challenges for instructors and learners. (Shu-Sheng *et al.*, 2007). E-learning environments increasingly serve as important infrastructural features of universities that enable teachers to provide students with different representations of knowledge and to enhance interaction between teachers and students, amongst student themselves. (Mahdizadah *et al.*, 2008). E-learning is an extremely adaptable technology that can be used to cover different delivery modes-self-paced, interactive or live learning can match the varied training needs. E-learning makes new knowledge and skills available immediately and reduces the learning time required to master even the most complicated topics. Benefits of E-learning have a favourable impact on the organizations profitability. (Deepak and Srivastava., 2005). Students, teachers and administrators now use technology extensively in their daily activities and have become reasonably technologically literate. The trend of using E-learning as a learning and teaching tool is now rapidly expanding into education. E-learning is the changing trend of education. E-learning, with all its characteristics defining its advantages and disadvantages is a major breakthrough in academic education and professional training. Various Universities worldwide have incorporated E-learning solution in their curriculum.

## NEED FOR THE STUDY

As highlighted by analyst Cappelli (2003) universities and other post-secondary institutions are far from being characterised by the 'idealistic notion of operating outside the daily financial grind of revenues, expenses and budgets'. The tertiary education sector is today a complex business and like others is cost-sensitive and eager to utilise the latest technologies to help streamline its operations. With this in mind, many educators have turned to online e-Learning in hopes of incorporating a more cost-effective means of education. Nevertheless online e-Learning does help widen the scope of education and can prove to be a vital asset, provided of course it is 'effective'. Paul J. Hu, John Milton *et.al* observed that Over all learning effectiveness (measured objectively and subjectively) associated with e-learning is significantly higher than that observed in the conventional classroom.

According to DFES (2003) E learning has the potential to transform the way we teach and learn across the board. It can raise standards, and widen participation in lifelong learning. It can enhance the quality and reach of their teaching, and reduce the time spent on administration. It can enable every learner to achieve his or her potential, and help to build an educational workforce empowered to change. It makes possible a truly ambitious education system for a future learning society". Hannan and Silver (2002) asserts that at a pedagogic level e-Learning is innovatory and creative and concerned with the enhancement of teaching and learning. After having observed these developments the researcher undertook a study on the Effectiveness of E-learning in teaching chemistry with reference to certain selected variables namely Nature of schools, Usage of computer, Internet facility, Usage of internet.

## Objectives

1. To study the post-test Scores of E-learning in Chemistry of Higher Secondary Students.
2. To study the gain Scores of E-learning in Chemistry of Higher Secondary Students.
3. To study the content scores of E-learning in Chemistry of Higher Secondary Students.
4. To find out whether there is any significant difference in the pre-test scores with reference to the background variables Nature of schools, Usage of computer, Internet facility, Usage of internet.
5. To find out whether there is any significant difference in the post-test scores with reference to the background variables Nature of schools, Usage of computer, Internet facility, Usage of internet.
6. To find out whether there is any significant difference in the gain scores with reference to the background variables Nature of schools, Usage of computer, Internet facility, Usage of internet.

## Hypotheses

1. The pre-test Scores of E-learning in Chemistry of Higher Secondary Students are low.
2. The post-test Scores of E-learning in Chemistry of Higher Secondary Students are low.
3. The gain Scores of E-learning in Chemistry of Higher Secondary Students are low.
4. There is no significant difference in the pre-test scores with reference to the background variables Nature of schools, Usage of computer, Internet facility, Usage of internet.
5. There is no significant difference in the post-test scores with reference to the background variables Nature of schools, Usage of computer, Internet facility, Usage of internet.
6. There is no significant difference in the gain scores with reference to the background variables Nature of schools, Usage of computer, Internet facility, Usage of internet.

## VARIABLES USED IN THE STUDY

### Dependent Variable

The E-learning Teaching Methodology.

### Independent Variable

Achievement in Chemistry.

### Background Variables

The background variables selected are Nature of schools, Usage of computer, Internet facility, Usage of internet.

## METHODOLOGY

The Single Group Experimental Method was adopted in this study and Purposive Sampling Techniques were applied. The researcher had chosen the pre-test and post-test single group design for conducting the experiment.

## Sample

The sample of this study consisted of 243, Higher Secondary First Year students chosen from seven Chemistry classes out of Seven Schools from the Puducherry. A total of 243 samples students studying higher secondary first year chemistry in and around Puducherry. The researcher had purposefully selected the sample.

### Descriptive Analysis

S.No	Variables	N	Mean	SD	Median	Min-Max
1	Pre-test Scores	243	7.16	4.32	7.00	0 - 100
2	Post-test cores	243	76.91	11.07	77.00	0 - 100
3	Gain Scores	243	69.75	8.35	70.00	0 - 100

The table of descriptive analysis shows that the distribution of Pre-Test Scores of E-learning in Chemistry of Higher Secondary Students. The Mean and SD of pre-test scores (N=243) is found to be 7.16 and 4.32 respectively. The Median of pre-test scores is found to be 7.00. The minimum score on pre-test of higher secondary students is 0 and the maximum is 100. There are 123 higher secondary students obtained above median and 120 obtained below Median.

The table of descriptive analysis shows the distribution of Post-Test Scores of E-learning in Chemistry of Higher Secondary Students. The Mean and SD of Post-Test Scores of E-learning in Chemistry of Higher Secondary Students (N=243) is found to be 76.91 and 11.07 respectively. The median of post-test scores is found to be 77.00. There are 125 higher secondary students obtained above median and 118 obtained below median. It is concluded that the post-test scores in the E-learning in chemistry of higher secondary students are above average.

The table of descriptive analysis shows the distribution of Gain Scores of E-learning in Chemistry of Higher Secondary Students. The Mean and SD of Gain Scores of E-learning in Chemistry of Higher Secondary Students (N=243) is found to be 69.75 and 8.35 respectively. The median of gain scores is found to be 70.00. There are 133 higher secondary students obtained above median and 110 obtained below median. It is concluded that the gain scores in the E-learning in chemistry of higher secondary students are above average.

## Hypothesis

There is no significant difference in the pre-test scores with reference to type of schools.

**Table.** Mean and Standard Deviation of Pre-Test Scores with respect to type of Schools

Type of Schools	N	Mean	SD
Government	95	7.45	4.30
Aided	34	7.24	3.98
Private	114	6.89	4.46

The Mean and SD of the pre-test scores for the type of schools are (7.45,4.30) (7.24, 3.98) and (6.89, 4.46) respectively with reference to Government, Aided and Private schools.

**Table.** Significant Difference between the type of School and the Pre-test scores

Sources of Variation	Sum Of Square	df	Mean Square	F	Level of Significant
Between groups	16.349	2	8.18	0.44	NS*
Within groups	4508.391	240	18.79		

NS\* - Not significant at 0.05 level

The mean squares of between groups and within groups for the pre-test scores is found to be 8.18 and 18.79 respectively with the F-value 0.44 for df (2,240) which is lesser than the table value. Hence the null hypothesis is accepted. It is concluded that there is no significant differences between type of schools in the Pre-test scores of higher secondary students.

## Hypothesis

There is no significant difference in the pre-test scores with reference to usage of computer.

**Table.** Mean and Standard Deviation of pre-test scores with respect to Usage of Computer

Usage of Computer	N	M	SD
At Home	80	6.81	4.08
At School	30	5.60	4.57
At Home & School	38	7.09	4.30
At Browsing Centre	95	7.75	4.43

The Mean and SD of Pre-test scores for the usage of computer are (6.81, 4.08), (5.60, 4.57), (7.09, 4.30) and (7.75, 4.43) respectively with reference to the usage of computer at home & school and browsing center.

**Table.** Significant difference between the usage of computer and the Pre-test scores

Sources of Variation	Sum of square	Df	Mean Square	F	Level of Significant
Between groups	97.453	3	32.48	1.75	NS*
Within groups	4427.288	239	18.52		

NS\*-Not significant at 0.05 level

The mean squares of between groups and within groups for the usage of computer is found to be 32.48 and 18.52 respectively with the F-value 1.75 for df (2,240) which is lesser than the table value. Hence the null hypothesis is accepted. It is concluded that there is no significant difference between usages of computer in the Pre-test scores of E-learning.

### Hypothesis

There is no significant difference in the pre-test scores with reference to usage of internet facility.

**Table.** Mean and Standard Deviation of Usage of Internet facility in the Pre-test Scores

Usage of Internet facility	N	M	SD
At Home	90	7.50	4.05
At School	20	8.22	5.09
At Home & School	23	7.64	4.03
At Browsing Centre	110	6.87	4.36

The Mean and SD of Pre-test scores for the usage of internet facility by the students at home, at school, at home & school and browsing center are (7.50, 4.05), (8.22, 5.09), (7.64, 4.03) and (6.87, 4.36) respectively.

**Table.** Significant difference between the usage of Internet facility and the Pre-test Scores

Sources of Variation	Sum of squares	df	Mean Squares	F	Level of Significant
Between groups	42.682	3	14.23	0.76	NS*
Within groups	4482.059	239	18.75		

NS\*-Not significant at 0.05 level

The mean squares of between groups and within groups for the pre-test scores is found to be 14.23 and 18.75 respectively with the F-value 0.76 for df (3,239) which is lesser than the table value. Hence the null hypothesis is accepted. It is concluded that there is no significant difference between the usage of Internet facility in the Pre-test of E higher secondary students.

### Hypothesis

There is no significant difference between the pre-test scores with reference to usage of internet.

**Table.** Mean and Standard Deviation of Usage of Internet and the pre-test scores

Usage of Internet	N	M	SD
Daily	22	9.18	4.27
Once in a Week	112	9.24	3.76
Very rarely	95	4.68	3.59
Never	14	4.14	2.38

The Mean and SD of the Pre-test scores for the usage of internet by the students daily, once in a week, very rarely and never. (9.18, 4.27), (9.24, 3.76), (4.68, 3.59) and (4.14, 2.38) respectively.

**Table.** Significant difference between the usage of Internet and the Pre-test scores

Sources of Variation	Sum of squares	df	Mean Squares	F	Level of Significant
Between groups	1284.736	3	428.25	31.59	S*
Within groups	3240.004	239	13.56		

The mean squares of between groups and within groups for the pre-test scores is found to be 428.25 and 13.56 respectively with the F-value 31.59 for df (3, 239) which is lesser than the table value. Hence the null hypothesis is accepted. It is concluded that there is a significant difference between the usage of Internet in the Pre-test scores of higher secondary students.

**Table.** Mean and Standard Deviation of Post-Test Scores of type of Schools

Type of schools	N	Mean	SD
Government	95	77.69	11.67
Aided	34	74.47	10.42
Private	114	76.97	10.72

The above table shows that the Mean and SD of the post-test scores on E-learning in chemistry for type of schools are (77.69, 11.67) (74.47, 10.42) and (76.97, 10.72) Government, Aided and Private school respectively.

**Table.** Significant Difference in the type of Schools on Post-test scores

Sources of Variation	Sum of squares	df	Mean Squares	F	Level of Significant
Between groups	261.284	2	130.64	1.07	NS*
Within groups	29369.539	240	122.37		

NS\*-Not significant at 0.05 level

The mean squares of between groups and within groups for the post-test scores is found to 130.64 and 122.37 respectively with the F-value 1.07 for df (2,240) which is lesser than the table value. Hence the null hypothesis is accepted. It is concluded that there is no significant difference between type of schools in the Post-Test scores of E-learning in Chemistry for higher secondary students.

## Hypothesis

There is no significant difference in the post-test scores with reference to usage of computer.

**Table.** Mean and Standard Deviation of Usage of Computer in the Post-test scores

Usage of Computer	N	M	SD
At Home	90	76.40	10.61
At School	20	74.85	10.35
At Home & School	23	83.65	9.56
At Browsing Centre	110	77.55	11.45

The Mean and SD of the post-test scores on E-learning in chemistry for the usage of computer are (76.40, 10.61), (74.85, 10.35), (77.57, 11.91) and (77.55, 11.45) at home, at school, at home & school and at browsing center respectively.

**Table.** Significant Difference between the usages of computer in the Post-test scores of E-learning in Chemistry

Sources of Variation	Sum of squares	Df	Mean Squares	F	Level of Significant
Between groups	1120.13	3	373.38	3.15	NS*
Within groups	28356.54	239	118.65		

NS\*- Not significant at 0.05 level

The mean squares of between groups and within groups for the post-test scores is found to be 373.38 and 118.65 respectively with the F-value 3.15 for df (3,239) which is lesser than the table value. Hence the null hypothesis is accepted.

It is concluded that there is no significant difference between usage of computer and the Post-test scores of E-learning in chemistry.

### Hypothesis

There is no significant difference between the post-test scores with reference to usage of internet facility.

**Table.** Mean and Standard Deviation of Usage of Internet facility of the post-Test scores of E-learning in Chemistry

Usage of Internet facility	N	M	SD
At Home	90	77.27	11.13
At School	20	77.67	12.05
At Home & School	23	79.64	10.54
At Browsing Centre	110	76.48	11.03

The Mean and SD of the Post-test scores on E-learning in chemistry for the usage of internet facility by the students at home, at school and at browsing center are (77.27, 11.13), (77.67, 12.05), (79.64, 10.54) and (76.48, 11.03) respectively.

**Table.** Significant difference between the usage of Internet facility and the Post-Test scores of E-learning in Chemistry

Sources of Variation	Sum of squares	df	Mean Squares	F	Level of Significant
Between groups	128.103	3	42.70	0.35	NS*
Within groups	29502.720	239	123.44		

NS\*-Not significant at 0.05 level

The mean squares of between groups and within groups for the post-test scores is found to be 42.70 and 123.44 respectively with the F-value 0.35 for df (3,239) which is lesser than the table value. Hence the null hypothesis is accepted. It is concluded that there is no significant difference between to various usage of Internet facility and the Post-test scores on E-learning in chemistry.



## Hypothesis

There is no significant difference between the post-test scores with reference to usage of internet.

**Table.** Mean and Standard Deviation of Usage of Internet and the post-test scores of E-learning in Chemistry

Usage of Internet	N	M	SD
Daily	22	83.50	9.52
Once in a Week	112	80.86	10.93
Very rarely	95	71.82	8.87
Never	14	69.29	9.08

The Mean and SD of the Post-test scores on E-learning in chemistry for the usage of internet by the students for daily, once in a weak, very rarely and never are (83.50, 9.52), (80.86, 10.93), (71.82, 8.87) and (69.29, 9.08) respectively.

**Table.** Significant difference between the usage of Internet and the Post-Test scores of E-learning in Chemistry

Sources of Variation	Sum of squares	Df	Mean Squares	F	Level of Significant
Between groups	5990.258	3	1996.75	20.19	S*
Within groups	23640.565	239	98.91		

S\*- Significant at 0.05 level

The mean squares of between groups and within groups for the post-test scores is found to be 1996.75 and 98.91 respectively with the F-value 20.19 for df (3,239) which is greater than the table value. Hence the null hypothesis is rejected. It is concluded that there is significant difference between the usage of Internet and the Post-test scores of E-learning in chemistry.

## Hypothesis

There is no significant difference between the gain scores with reference to type of schools.

**Table.** Mean and Standard Deviation of Gain Scores of Type of Schools

Type of Schools	N	Mean	SD
Government	95	70.24	9.18
Aided	34	67.24	7.46
Private	114	70.08	7.79

The Mean and SD of the gain scores on E-learning in chemistry for the type of schools are (70.24, 9.18) (67.24, 7.46) and (70.08, 7.79) respectively with reference to Government, Aided and Private schools.

**Table.** Significant difference between the type of schools and the Gain Scores of E-learning in Chemistry

Sources of Variation	Sum of squares	Df	Mean Squares	F	Level of Significant
Between groups	250.342	2	125.17	1.81	NS*
Within groups	16625.839	240	69.27		

NS\*-Not significant at 0.05 level

The mean squares of between groups for the gain scores is found to be 125.17 and 69.27 respectively with the F-value 1.81 for df (2,240) which is lesser than the table value. Hence the null hypothesis is accepted. It is concluded that there is no significant difference between type of School and the Gain scores of E-learning.

### Hypothesis

There is no significant difference between the gain scores in E-learning in Chemistry with reference to usage of computer.

**Table .** Mean and Standard Deviation of Usage of Computer in the Gain scores

Usage of Computer	N	M	SD
At Home	90	69.59	7.90
At School	20	69.25	7.70
At Home & School	23	77.43	8.42
At Browsing Centre	110	69.81	8.53

The Mean and SD of the gain scores on E-learning in chemistry for the usage of computer by the students at home, at school, at home & school and at browsing center are (69.59,7.90), (69.25,7.70), (77.43, 8.42) and (69.81, 8.53) respectively.

**Table.** Significant difference between the usages of computer and the Gain scores

Sources of Variation	Sum of squares	Df	Mean Squares	F	Level of Significant
Between groups	1262.295	2	20.765	6.22	S*
Within groups	16170.182	239	76.66		

S\*-Significant at 0.05 level

The mean squares of between groups and within groups for the gain score is found to be 6.64 and 70.53 respectively with the F-value 0.10 for df (3, 239) which is greater than the table value. Hence the null hypothesis is rejected. It is concluded that there is significant difference between the usage of computer and the Gain scores of E-learning in chemistry.

### Hypothesis

There is no significant difference in the gain scores with reference to the usage of internet facility.

**Table.** Mean and Standard Deviation of Usage of internet facility and the Gain scores

Usage of Internet facility	N	M	SD
At Home	90	69.77	8.45
At School	20	69.44	9.71
At Home & School	23	72.00	9.91
At Browsing Centre	110	69.61	8.09

The Mean and SD of the gain scores on E-learning in chemistry for the usage of internet facility by the students at home, at school, at home & school and at browsing center are (69.77, 8.45), (69.44, 9.71), (72.00, 9.91) and (69.61, 8.09) respectively.

**Table.** Significant difference between the usage of Internet facility and the Gain scores of e-learning in chemistry

Sources of Variation	Sum of squares	Df	Mean Squares	F	Level of Significant
Between groups	60.380	2	20.13	0.29	NS*
Within groups	16815.801	239	70.36		

NS\*-Not significant at 0.05 level

The mean squares of between groups and within groups for the gain scores is found to be 20.13 and 70.36 respectively with the F-value 0.29 for df (3,239) which is lesser than the table value. Hence the null hypothesis is accepted. It is concluded that there is no significant difference between various usage of Internet facility and the Gain scores of E-learning in chemistry.

## Hypothesis

There is no significant difference in the gain scores with reference to usage of internet.

**Table.** Mean and Standard Deviation of Usage of Internet and the Gain scores

Usage of Internet	N	M	SD
Daily	22	74.32	6.87
Once in a Week	112	71.63	8.51
Very rarely	95	67.14	7.29
Never	14	65.14	8.95

The Mean and SD of gain scores on E-learning in chemistry for the usage of internet by the students belonging to daily, once in a week, very rarely and never are (74.32, 6.87), (71.61, 8.51), (67.14, 7.29) and (65.14, 8.95) respectively.

**Table.** Significant difference between the usage of Internet and the Gain scores

Sources of Variation	Sum of squares	Df	Mean Squares	F	Level of Significant
Between groups	1802.482	3	600.83	9.53	S*
Within groups	15073.699	239	63.07		

S\*- significant at 0.05 level

The mean squares of between groups and within groups for the gain scores is found to be 600.83 and 63.07 respectively with the F-value 9.53 for df (3,239) which is higher than the table value. Hence the null hypothesis is rejected.

It is concluded that there is significant difference between the usage of Internet and the Gain scores of E-learning in chemistry.

## CONCLUSION

The post-test scores in the E-learning in chemistry of higher secondary students are above average.

The gain scores in the E-learning in chemistry of higher secondary students are above average.

There are no significant differences between type of schools, usages of computer, usage of Internet facility and usage of Internet in the Pre-test scores of higher secondary students.

There is no significant difference between type of schools, usage of computer and usage of Internet facility in the Post-Test scores of E-learning in Chemistry for higher secondary students.

There is significant difference between the usage of Internet and the Post-test scores of E-learning in chemistry.

There is no significant difference between type of School and usage of Internet facility and the Gain scores of E-learning.

There is significant difference between the usage of computer and usage of Internet and the Gain scores of E-learning in chemistry.

## Suggestions

The impact of E-learning or any technology depends on the scope for access and the usability of the technology. Teachers should find ways for using E-learning teaching strategy to enhance teaching effectiveness. The teachers should motivate the students to make use of computer as well as internet as routine in the process of learning. They should be familiarized to use the internet periodically and the students be tamed to use web for their purpose of learning and their other academic endeavours.

Moreover, the institutional facility with regards to E-learning causes change in the effectiveness of teaching. The institutions should try to make use of blended learning strategies, that is face to face as well as online learning. So that it will enable the teachers to provide different dimensions of knowledge and enhance interaction between teachers and students. Starting to implement something new is always a challenge. Since E-Learning is a popular and viable medium to provide education, initiatives need to be taken for the earlier implementation of E-learning methodology.

Teachers need to be allowed to use technology as a tool, which will enable them to collect information, analyze and disseminate to the students. Teachers need the support from the institution in order to make use of new technologies in the teaching learning process. It is

necessary that, in the near future, E-learning environments are to be made popular among schools in the Indian scenario.

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## REFERENCES

- Cappelli, G., 2003. E-learning in the postsecondary education market: A view from wall street. Upper Saddle River, NJ: Financial Times/Prentice Hall, Pearson Education Inc.
- Deborah, L.L., B.-m. Tempa and R.M. Gary, 1998. Moving from computer literate to technology competent: The next educational reform. *Computers in Human Behaviour*, 14(1): 93-109.
- Deepak, K. and Srivastava., 2005. E-learning: A new way of education. *University News*, 43(26).
- DFES, D.f.E.a.S., 2003. Towards a unified e-learning strategy – consultation document. Available from <http://www.dfes.govt.uk/publications/e-strategy/docs/e-strategy.pdf>.
- Hannan, A. and H. Silver, 2002. Guide to innovation in teaching and learning [electronic version]. LTSN Generic centre.
- Mahdizadah, H., B. Harm and M. Martin, 2008. Determining factors of the use of e-learning environments by university teachers. *Computers & Education*, 51(1): 142-154.
- Shu-Sheng, L., H. Hsiu-Mei and C. Gwo-Dong, 2007. Surveying instructor and learner's attitude towards e-learning. *Computers & Education*, 49(4): 1066–1080.

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