A Comparison of Students' Attitudes Between Computer Software Support and Traditional Laboratory Practical Learning Environments in Undergraduate Electronics Science

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Abstract

The purpose of this experimental study was to see the effect of Computer software support on the attitude towards electronics subject of students while working in laboratory of electronics science. In this experimental study there were two groups as experimental group and control group. The experimental group performed the experiments using computer software support for selected practical in electronics, while controlled group was studied by traditional method.

The target population consisted of students offering electronics subject in undergraduate science streams. The sample was students who attended the Electronics achievement test at four selected science colleges affiliated in Amravati University Amarvati (Maharashtra state-INDIA).There were 150 students used as the sample in the study.

The investigator developed an attitude scale having 25 items by covering various aspects related to electronics experiments and laboratory communication. There ware 21 positive and four negative items on five-point scale (Likert type). The difference of points in pre test and posttest decided the change in Attitude.

The findings showed that the computer software support used for laboratory communication was much effective in bringing an attitudinal change among the students. There was a remarkable enhancement in attitude for all items.

Introduction

Advancing technology has opened many doors in education. During the last years, software tools in various forms have started playing an increasing important role in educating students of traditionally hard engineering subjects like electrical, mechanical or civil engineering.

With computer-based tools becoming more affordable we have the expectation that time and distance factors will have less impact on the way instruction is delivered to students of such subjects. While laboratory-based training does not seem to be due for replacement by software model-based training in the foreseeable future, instructional software can be used as a complementary tool during laboratory work. For instance, the theoretical background of the laboratory work can become available to the students through multimedia software, preparation of the laboratory exercises and contacting of the laboratory experiments can be supported by computer systems, used for collecting data, processing measurements, testing wiring and equipment configurations, simulating behavior of equipment etc. appropriate use of this educational software allows students to build knowledge by giving them opportunities to explore the equipment to be used beforehand in a safe for them and the machinery way, interact with it, experiment, problem-solve, and collaborate. Interactive, multimedia experience cannot replace the real laboratory work but can enhance the learning process of many students, help them find the relation between the theoretical principles and observed behavior in an easy and intuitive way.

Computers can also be used to design and access supplemental references. These can be effectively used before a lab to increase familiarity with certain lab procedures. This has shown to be true in an experiment involving Electronics science students on an undergraduate level. In this study there were two groups as experimental group and control group. The experimental group performed the experiments using Computer software support for selected practical in electronics, while controlled group was studied by traditional method (Print material and demonstration of experiments). An attempt has been made to prepare Computer software support on laboratory practical learning and its effectiveness on student's attitudinal change has been studied. The investigator developed an attitude scale having 25 items by covering various aspects related to electronics experiments and laboratory communication. There ware 21 positive and four negative items on five-point scale (Likert type). Certain steps in the laboratory experiment deemed essential in acquiring accurate results were selected. The students were analyzed individually. The numbers of these steps performed by all the students were noted. The Aim of Computer software support was given under:

1. To communicate the basic knowledge (theory) related to practical work in electronics.
2. To assist the students in selecting the measuring instruments and electronics components require performing an experiment in laboratory.
3. To develop the competency of assembling the practical circuit.
4. To communicate procedure (demonstration) of an experiment.
5. To reduce the labor of calculation and to obtain accuracy in design, results etc

The results reveal that the computer software support used for laboratory communication was much effective in bringing an attitudinal change among the students. There was a remarkable enhancement in attitude for all items.

Background

Many researchers have studied the effects of using computers in various components of classrooms. In general, the research has looked at the effects of computer use in attitudes. This area is summarized below.

One of the recurring advantages attributed to using computers in the classroom is that of more positive student attitudes (Brasell, 1987 [3]; Brungardt & Zollman, 1995, [4]). Using computers in a classroom is believed to lead to more positive attitudes in students, because computers can do so many new things so quickly, so carefully, and because many students prefer using computers. There is little research, however, to support such claims. The limited research available suggests that computers can lead to more positive attitudes in some groups of students (males, younger students).

Although the importance of hands-on labs to the science curriculum cannot be denied, Garcia (1995) [17], cites several advantages of computer simulations compared to laboratory activities. First, there appear to be important pedagogical advantages of using computer simulations in the classroom. Second, the purchase, maintenance, and update of lab equipment is often more expensive than computer hardware and software. Also, there is no concern for students' physical safety in this learning environment.

Thomas and Hooper (1989) [34], discuss the instructional use and sequencing of computer simulation and its effect on students' cognitive processes. The sequence in which learning occurs influences the stability of cognitive structures (Ausubel, 1968) [1]. New knowledge is made meaningful by relating it to prior knowledge and optimization of prior knowledge is done through sequencing. According to Gokhale (1991) [18], simulations used prior to formal instruction build intuition and alert the student to the overall nature of the process. When used after formal instruction, the program offers the student an opportunity to apply the learned material.

There is evidence that simulations enhance students' problem solving skills by giving them an opportunity to practice and refine their higher-order thinking strategies (Quinn, 1993) [27]. Computer simulations were found to be very effective in stimulating environmental problem solving by community college students (Faryniarz & Lockwood, 1992) [16]. In particular, computer simulation exercises based on the guided discovery learning theory can be designed to provide motivation, expose misconceptions and areas of knowledge deficiency, integrate information, and enhance transfer of learning (Mayes, 1992) [25]. In three studies, students using the guided version of computer simulation surpassed unguided students on tests of scientific thinking and a test of critical thinking (Rivers & Vockell, 1987), [33]. As a result of implementing properly designed simulation activities, the role of the teacher changes from a mere transmitter of information to a facilitator of higher-order thinking skills (Woolf & Hall, 1995), [36]. According to Magnusson and Palincsar (1995) [24], simulations are seen as a powerful tool to teach not only the content but also thinking or reasoning skills that are necessary to solve problems in the real world.

Purpose of the study

The purpose of this experimental study was to see the effect of Computer software support on the attitude towards electronics subject of students while working in laboratory of electronics science.

The following research questions were examined in this study: will there be significant change in the level of attitude of the target group towards electronics subject. It is hypothesized that There will be significant change in the level of attitude of the target group towards electronics subject.

Methodology

Population & Sample

For the sake of convenience the investigator limited this experiment within Amravati Division of Maharashtra State, in India. There are 12 colleges in Amravati University, which offer Electronics subject in U.G. level. The total population was 656 (including FY B.Sc, SY B.Sc & TY B.Sc.).

As a research work is related with practical work, also because of administrative limitations, Subject availability (Computer lab) and as per the advice of the experts in this field and by judging from the point of reliability and depth of information, the four colleges affiliated to Amravati University (India), were selected

On the basis of learner's performance in proposed achievement test in electronics, they were placed into two groups, each of 150. The sampling was done by stratified random sampling method. A 't' test was administered to find out the significance of the difference between the mean scores of the control group and experimental group in the pre test. The analysis provided that there was no significant difference between the two groups. It established the fact that the two groups selected on the basis of the achievement test was nearly equivalent.

Tools Construction

For the present study, the investigator prepared Computer software using mixed mode design written in Visual basic, Visual C++, HTML and SPICE. The investigator had seen that the frames ware unambiguous, brief, simple and straightforward. Sequential presentation of frames for each of different modes of computer software viz, Demonstration, laboratory guide, experimental result and error verification, and simulation, (Gandole, 2005, [37]). The investigator selected the following experiments in Electronics syllabus of B.Sc. Syllabus.

FY.B.Sc:

6. 1. Verification of Thevenin's Theorem.
7. Construction and study of characteristics of PN Junction diode.
8. Construction and study of half-wave rectifier.
9. Construction and study of transistor under CB mode.
10. Construction and calibration of series type ohmmeter.

SY.B.Sc.

11. Study of Zener regulated power supply.
12. To construct and verify the working of OP-Amp as inverting Amplifier.
13. To Construct and study of transistorized Astable Multivibrator.
14. To Construct and study of diode circuit as clipper.
15. To construct and study UJT as relaxation Oscillator.

TY.B.Sc.

1. To construct and study of OP-Amp as Astable Multrivibrator.
2. Study of Amplitude Modulation.
3. To construct and study of OP-Amp as Monostable Multrivibrator.
4. To construct and study of OP-Amp as Regenerative Comparator.
5. To construct and study of OP-Amp as Bistable Multrivibrator.

The investigator developed an attitude scale (shown in appendix - A) having 25 items by covering various aspects related to electronics experiments and laboratory communication. There ware 21 positive and four negative items on five-point scale (Likert type). The students from both groups had ticked a column of their choice (One out of five). The marking for positive item was 5,4,3,2,1 while that of negative item was 1,2,3,4,5. There was possibility of getting 25 (minimum) and 125 (maximum). The points obtained in pretest and posttest was calculated as shown in table below. The difference of points in pre test and posttest decided the change in Attitude. The investigator for the purpose of analysis developed following scale.

Value	**No change**	**Some change**	**Remarkable change**	**High change**	**Very high change**
Points (d)	**0-10**	**11-20**	**21-30**	**31-40**	**Above 41**

Findings

There ware 25 statements in the attitude test developed on five-point scale (Likert type). It was given twice as pretest and posttest and the total weightage was compared as shown in table 1 (for experimental group and control group).

1. Table No1. Summarizes the analysis of attitude scale responses of FY.B.Sc. SY. B.Sc. and TY. B.Sc. students for experimental group and control group.

(A) For FY. B.Sc. students of Experimental group : A difference of more than 40 points for statement No. 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24 & 25 revealed that there was very high change in the attitude towards electronics subject. A difference of 38 points for statement No. 1 and 8 revealed that there was high change in the attitude towards electronics subject.

(B) For FY.B.Sc. students of control group: A difference of more than 40 points for statement No. 22 revealed that there was very high change in the attitude towards electronics subject. A difference of 21 and 22 points for statement No. 7 and 9 respectively revealed that there was remarkable change in the attitude towards electronics subject. A difference of 11 to 20 points for statement No. 1, 2, 4, 5, 6, 8, 10, 11, 12, 13, 14, 15, 16, 18, 21, 23 and 24 revealed that there was some change in the attitude towards electronics subject. A difference of 0 to 10 points for statement No. 17, 19, 20 and 25 revealed that there was no change in the attitude towards electronics subject.

(C) For SY.B.Sc. students of experimental group: A difference of more than 40 points for statement No. 1, 2, 3, 6, 9, 10, 11, 14, & 24 revealed that there was very high change in the attitude towards electronics subject. A difference of 31 to 40 points for statement No. 4, 5, 8,

13, 16, 17, 18, 19, 21, 22, 23 and 25 revealed that there was high change in the attitude towards electronics subject. A difference of 30, 22 and 25 points for statement No. 7, 12 and 15 respectively revealed that there was remarkable change in the attitude towards electronics subject.

(D) For SY.B.Sc. students of control group: A difference of 0 to 10 points for all 25 statements revealed that there was no change in the attitude towards electronics subject.

(E) For TY.B.Sc. students of experimental group: A difference of 31 to 40 for all statements except statement No. 12 and 20 revealed that there was high change in the attitude towards electronics subject. A difference of 25 and 29 points for statement No. 12 and 20 respectively revealed that there was remarkable change in the attitude towards electronics subject.

(F) For TY.B.Sc. students of control group: A difference of 0 to 10 points for all 25 statements revealed that there was no change in the attitude towards electronics subject.

Table 1. Attitude scale analysis :(d= Difference between Pre Attitude and Post Attitude)

Item No	*FY. B.Sc.*				*SY. B.Sc.*				*TY. B.Sc.*			
	Experimental Group		Control Group		Experimental Group		Control Group		Experimental Group		Control Group	
	Result (d)	***Remark***	***Result (d)***	***Remark***	***Result (d)***	***Remark***	***Result (d)***	***Remark***	***Result (d)***	***Remark***	***Result (d)***	***Remark***
1	24	Remarkable change	16	Some change	45	Very High Change	8	No Change	36	High Change	10	No Change
2	31	High change	14	Some change	47	Very High Change	3	No Change	38	High Change	7	No Change
3	24	Remarkable change	15	Some change	44	Very High Change	6	No Change	36	High Change	1	No Change
4	26	Remarkable change	12	Some change	35	High change	3	No Change	31	High change	7	No Change
5	21	Remarkable change	12	Some change	35	High change	4	No Change	31	High change	7	No Change
6	26	Remarkable change	11	Some change	45	Very High Change	2	No Change	33	High Change	7	No Change
7	42	Very high	14	Some	30	Remarka	2	No	32	High	6	No Change

		change		change		ble change		Change		change		
8	35	High change	19	Some change	35	High change	3	No Change	31	High change	3	No Change
9	31	High change	12	Some change	45	Very High Change	2	No Change	37	High Change	4	No Change
10	20	Some change	13	Some change	45	Very High Change	9	No Change	36	High Change	9	No Change
11	24	Remarkable change	11	Some change	45	Very High Change	2	No Change	36	High Change	5	No Change
12	24	Remarkable change	12	Some change	22	Remarka ble change	2	No Change	25	Remarka ble change	4	No Change
13	15	Some change	13	Some change	35	High change	2	No Change	32	High change	2	No Change
14	13	Some change	11	Some change	41	Very High Change	3	No Change	35	High Change	2	No Change
15	16	Some change	16	Some change	25	Remarka ble change	1	No Change	36	High change	4	No Change
16	25	Remarkable change	12	Some change	35	High change	5	No Change	34	High change	3	No Change
17	95	Very high change	13	Some change	38	High change	4	No Change	30	High change	4	No Change
18	34	High change	13	Some change	38	High change	3	No Change	32	High change	2	No Change
19	7	No change	7	No change	31	High change	2	No Change	32	High change	2	No Change
20	28	Remarkable change	12	Some change	25	Remarka ble change	3	No Change	29	Remarka ble change	2	No Change
21	22	Remarkable change	19	Some change	35	High change	4	No Change	34	High change	2	No Change
22	24	Remarkable	11	Some	34	High	5	No	31	High	4	No Change

		change		change		change		Change		change		
23	28	Remarkable change	15	Some change	33	High change	5	No Change	32	High change	1	No Change
24	37	High change	12	Some change	40	High change	9	No Change	34	High change	5	No Change
25	34	High change	8	No change	33	High change	4	No Change	36	High change	4	No Change

An overall attitudinal change about activity No. 01 to 25 is given in table 2.

An overall difference 1308 points for F.Y.B.Sc. experimental group, 390 points for F.Y.B.Sc. control group, 916 points for S.Y.B.Sc. experimental group, 96 points for S.Y.B.Sc. control group, 829 points for T.Y.B.Sc. experimental group, 107 points for T.Y.B.Sc. control group indicated that there was a mean difference of 52.32 points per activity for F.Y.B.Sc. experimental group, a mean difference of 15.6 points per activity for F.Y.B.Sc. control group, a mean difference of 36.64 points per activity for S.Y.B.Sc. experimental group, a mean difference of 3.84 points per activity for S.Y.B.Sc. control group, a mean difference of 33.2 points per activity for T.Y.B.Sc. experimental group and a mean difference of 4.28 points per activity for T.Y.B.Sc. control group. A difference of 52.32 points per activity revealed that there was very high change in the attitude of F.Y.B.Sc.experimental group students towards electronics subject. A difference of 15.6 points per activity revealed that there was some change in the attitude of F.Y.B.Sc. control group students towards electronics subject. A difference of 36.64 points per activity revealed that there was high change in the attitude of S.Y.B.Sc. experimental group students towards electronics subject. A difference of 3.84 points per activity revealed that there was no change in the attitude of S.Y.B.Sc. control group students towards electronics subject. A difference of 33.2 points per activity revealed that there was high change in the attitude of T.Y.B.Sc. experimental group students towards electronics subject. A difference of 4.28 points per activity revealed that there was no change in the attitude of T.Y.B.Sc. control group students towards electronics subject.

Table 2 : Attitudinal change about (activity No. 01 to 25)

Group	**Frequency**	**SA**	**A**	**U.D.**	**D**	**S.D.**	**Total points**	**Results**
F.Y.B.Sc.								
Experimental	Pretest (Fe)	36	380	546	253	35	3979	D*=1308
	Posttest (Fo)	331	641	59	138	81	5287	d*=52.32
Control	Pretest (Fe)	58	347	585	223	37	4040	D=390
	Posttest (Fo)	164	598	71	340	77	4430	d=15.6

S.Y.B.Sc.								
Experimental	Pretest (Fe)	199	534	105	332	86	4424	D=916 d=36.64
	Posttest (Fo)	409	586	05	160	90	5340	
Control	Pretest (Fe)	205	533	103	329	84	4430	D=96 d=3.84
	Posttest (Fo)	215	556	76	347	61	4526	
T.Y.B.Sc.								
Experimental	Pretest (Fe)	228	549	83	298	92	4557	D=829 d=33.2
	Posttest (Fo)	432	565	00	148	100	5386	
Control	Pretest (Fe)	223	544	99	301	83	4563	D= 107 d=4.28
	Posttest (Fo)	240	586	29	328	67	4670	

D* = Total difference of points.

d *= Mean difference of points per activity.

Conclusion

It was found that the experimental group had high attitude towards various activities. The computer software support could raise their attitude about interest in electronics subject and practical, stimulating electronics practical, understanding theory related with practical concepts, liking of electronics practical, enjoying electronics practical, ease in electronic experiment, positive reaction in electronics, implementing ideas in electronics laboratory, getting good grades in electronics subject, to reduce labor of calculation, understanding electronics concepts, availability of laboratory manual on line, to perform the experiment with minimum human support, confidence in ability to do electronics practical, comfortable working with laboratory equipment, taking more electronics courses in future, participation in electronics discussion. It was concluded that the computer software support used for laboratory communication was much effective in bringing an attitudinal change among the students. There was a remarkable enhancement in attitude for all items.

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Appendix – a:

Attitude scale:

Each of the statements below expresses a feeling toward electronics practical. Please rate each statement on the extent to which you agree. For each, you may:

SA	A	U	D	SD
strongly agree	agree	be undecided	disagree	strongly disagree

S.No	Items	SA	A	U	D	SD
1	Electronics is very interesting to me.					
2	Laboratory work developed my interest in electronics					
3	I am always under a terrible strain in a electronics Lab.					
4	Electronics practical is fascinating and fun.					
5	Electronics practical makes me feel secure, and at the same time is stimulating					
6	Electronics practical makes me feel comfortable.					
7	In general, I have a good feeling toward Electronics					
8	Laboratory practical helps me to understand					

	electronics theory.					
9	I approach Electronics experiment with a feeling of hesitation.					
10	I really like Electronics practical.					
11	I have enjoyed studying Electronics practical.					
12	It makes me nervous to even think about doing a electronics experiment					
13	I feel at ease in electronics experiments and like it very much					
14	I feel a definite positive reaction to Electronics; it's enjoyable					
15	I can implement my ideas in electronics laboratory.					
16	I can get good grades in electronics.					
17	I have to spends too much time on calculation and graphs and not time on the underlying concepts or ideas after completing the experiment in Electronics					
18	I find the labs help me better understand electronics concepts					
19	I do not need to read my laboratory manual to succeed in the experiment					
20	I can perform the experiments without human support.					
21	I am confident in my ability to do Electronics practicals.					
22	I am comfortable working with laboratory equipment.					
23	I would be happy to take more Electronics courses.					
24	Often in laboratory I understand the concept behind the lab experiment					
25	I participate in Electronics discussions often, and it is enjoyable.					