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The Impact of Blended Learning Environment on Academic Achievement of Engineering Students

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Abstract: ***Blended learning is one of the e-learning models integrating an online course and face-to-face classroom by optimizing the use of ICT as instructional media to enhance the teaching and learning experience for the teachers and students. The main aim of this research study explores the impact of the Blended Learning Environment on students' academic achievement. Quasi-experimental design research methodology was used in this study. The sample was drawn from Government Diploma Polytechnic college in Karaikudi, Tamil Nadu, India. The tools utilized for data collection were Blended Learning Environment and Academic achievement test. For six weeks, the students in the control group were treated with Lecture Based Environment (LBE) where the conventional lecture method of teaching was adopted, while the experimental group were carried out through the Blended Learning Environment (BLE) where both on-line and face to face modes are adequately utilized based on the subject matter. Two groups were administered a test before and after the implementation of BLE. To analyze the data, t-test was conducted to compare the test mean scores of both groups. Further, the gap closure analysis was used to find out and ensure the effectiveness of the experimental treatment. The results revealed that there were statistically significant differences between the scores of the two groups. The study concluded that blended learning improves students' academic achievement. This study also testifies that BLE is more conducive to improve academic achievement than LBE.***

Keyword: Blended learning environment, Lecture-based Environment, academic achievement.

I. INTRODUCTION

The rapid advancement of internet and digital technologies in recent decades triggered more educational opportunities to learn outside classrooms and provides a new theme for prospective learners to learn knowledge in a more suitable and flexible way. In this new paradigm of the so-called e-Learning, many efforts have been made to build web-based learning management systems (LMS) that deliver controllable processes of learning activities with desired curricular contents [1]. The use of technology in education may promote learners' critical thinking, problem-solving, and collaborative learning [2].

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Though Technology effectively diffused in the teaching and learning environment for the betterment of learners, the role of the teacher cannot completely be replaced by it. This leads to a compromissory approach known as Blended Learning, a new form of teaching and learning that integrates the use of ICTs with the face to face learning.

The term blended learning is used to define the learning that blends a range of event-based activities, containing face to face classrooms; self- faced learning and live e-learning. This learning is not just adding educational materials documents, and resources across the internet, but it should be associated and needs a teaching entry which suits the characteristics of learners and scholarly subjects. A stronger learning environment has emerged by combining the strongest aspects of the few available approaches to remove the deficiencies of existing conventional learning and web-based learning.

A. Blended Learning Environment

Garison and Vaughan (2008) defined blended learning as knowledge combination of electronic learning and face to face learning [3]. Science and technology encyclopedia defines blended learning as an approach which combines different educational methods such as online learning and traditional of the internet [4]. Blended learning combines online delivery of educational content with the best features of classroom interaction [5]. Further, Blended learning environment consists of integrates instructional approaches in and out of the classroom in order to enhance the learning productivity or outcome and diminishing the cost. This definition consists of various learning methods (discussion, practice, conference, simulation, case study etc.), various teaching methods (in class or online learning), various guidance techniques (computer-supported, individual, group study) and various timings (synchronous or asynchronous) [6] [7]. Blended learning is a combination of the strong advantageous sides of face-to-face learning and web-based learning. The flexibility of blended learning has the ability to be adopted in diverse formats. [8] [9]. In accumulation to these features, technological developments would create blended learning as a preferable learning approach by educational institutions in the future [10]. Selvakumar & Sivakumar [11] suggested that the blended learning is the one of e-learning modality incorporating an online course and real face-to-face classroom by augmenting the utilization of ICTs as instructional media to enrich the teaching-learning experiences for the teachers and students.

Many research studies support to adopt blended learning strategy to enhance the problem-solving process, motivation levels, and academic achievement. After reviewing the buddying of blended learning studies, the researcher did not find any study that explores the effect of the blended learning environment on the academic achievement in Physics among the Engineering students at Diploma level. Therefore, this research study has been carried out to identify the impact of the blended learning environment on academic achievement among engineering students at Diploma level. Furthermore, as suggested by [16] the gender has been included as a demographic variable for this study.

B. Objectives

In accordance with this main aim, the objectives presented below are investigated:

1. To find out the significance of the difference in the academic achievement of control group students between pre- and post-tests.
2. To know whether there is any significant difference in the academic achievement of experimental group students between pre and post-tests.
3. To access the significance of the difference in post-test academic achievement scores of experimental and the control groups students.

C. Hypotheses

1. There is no significant difference in the academic achievement scores of control group students between pre and post-tests when the subject is learned through Lecture Based Environment (LBE)
2. There exists a significant difference in the academic achievement scores of experimental group students between pre and post-tests when the subject is learned through Blended Learning Environment (BLE).
3. There is a significant difference in the post-test performance between the control and the experimental groups of students.
4. There is no significant difference in the mean gain scores of the experimental group in terms of gender.

II. METHODOLOGY

A. Research Design

A quasi-experimental design was adopted to explore the impact of the blended learning environment on students' academic achievement. The selection of the design was based on the recommendation of [17] who stated that quasi-experimental design should be accepted when research includes finding out about the impact of a treatment on a group of people. The independent variables of the study are Blended Learning Environment (BLE) and Lecture Based Environment (LBE) the dependent variable is academic achievement in Physics.

Table 1: Design of the study

Group	Pre-test	Treatment	Post-test
Control	Achievement test	X_{LB}	Achievement test
Experimental	Achievement test	X_{BL}	Achievement test

B. Participants

The participants of the study consisted of 50 students studying Diploma course in Basic Engineering and having the subject Physics in a Government Polytechnic college in the 2018-2019 academic year. A homogenous group of 50 students selected based on age, and academic achievement, of which 25 students were randomly assigned to the experimental group (Male-13 Female-12) and another 25 students were randomly assigned to control group (Male-14 Female-11). Before the treatment, all participants received training for primary computer-oriented skills to avoid probable problems inefficient utilization of computers and internet throughout the experimental process.

C. Procedure

For the present investigation, Station Rotation Model described by Heather Staker and Micheal B.Horn [18] has been implemented. According to them, in this particular model students rotate on a fixed schedule or at the teacher's discretion among classroom-based learning methods. This model contains at least one station for online learning mode. Other stations may include activities such as small group or full - class instruction. Some adaptation involves the entire class interchanging among activities together, whereas others divided the class into a small group or one by one rotation [5]. In the present study, the teacher-led instruction method was given to the entire class, whereas for collaborative activities the class was divided into four groups. Each group had four members. On line learning was offered separately to the students.Based on the expert's opinion, the investigator selected the unit entitled 'Heat' and 'Thermodynamics', in the Engineering Physics volume II for Diploma in Basic Engineering syllabus for the development of Blended Learning Environment (BLE) and Lecturer Based Environment (LBE). Besides, the learning content was analyzed and various learning objectives were recognized. After the identification of the unit, the investigator developed the Blended Learning Environment (BLE) comprised of a content-based unit, various selected videos and other relevant E-resources. The developed package was handed over to the technical experts, subject experts, and senior lecturers to give experts' opinion. The comments and notes of the experts were considered and some alterations were carried out in the development of the package. Then, for the development of Lecture Based Environment the investigator constructed conventional lesson plans based on Bloom's taxonomy. An achievement test was also constructed to measure the academic achievement level among students, which involved 25 questions of dichotomous questions and multiple-choice questions.

The calculated reliability value of Achievement Test using Cronbach Alpha was 0.79 and this value is accepted for the purposes of this study.

D. Data Collection

The study included two groups of participants. The experimental group was learned through using BLE and the control group was through LBE. The above methods were adopted in six weeks to both groups. The pre-test was conducted at the commencing of the treatment to both control and experimental groups. The investigator administered the BLE on experimental group and LBE on control group for six weeks. At the end of the treatment session, control and experimental groups responded to the post-test.

E. Data Analysis

The researchers utilized the following statistical analyses: i) Means and Standard Deviations to compute academic achievement with respect to group variable, ii) T-test to check the equalization of study groups and to calculate the significance of the difference in the effect of group on academic achievement. Data attained from the study is analyzed with SPSS, and hypotheses of the study are tested at the 0.95 (p=0.95) confidence level.

III. FINDINGS

A. Results

In this section, the results and discussion about the data analysis related to the objectives are given hereunder. The results of the independent samples t-test with respect to academic achievement pre-test scores of the control and experimental group students before adopting the treatment are given in table-2.

Table 2: The results of the t-test according to the Pre-test scores of the control and experimental groups

Group	N	Mean	SD	df	t	P
Control	25	6.6	1.258	48	0.4878	0.6279
Experimental	25	6.76	1.052			

As table 2 shows, the average pre-test scores of the students in the control group is 6.6 with standard deviation 1.258, whereas the average pre-test scores of the students in the experimental group is 6.76 with standard deviation 1.052. It is seen that the average scores of the two groups are very close to one another. The difference between the average pre-test scores of the students which based on two different groups is statistically not significant [P= 0.6279 > 0.05]. According to this result, it can be inferred that the academic achievement of both groups are similar that no statistical difference has been found. Thus, the homogeneity of the groups is well established before the treatment.

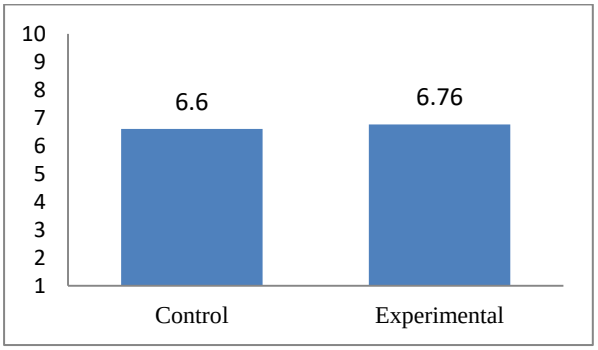

Figure 1: Graphical representation of pre-test mean values of the control and experimental groups.

B. Results on Hypotheses

H_{01}: 1. There is no significant difference in the academic achievement scores of control group students between pre and post-tests when the subject is learned through Lecture Based Environment (LBE)

Table no (3) refers to the analyses for testing the above hypothesis,

Table 3: The results of the t-test according to the pre and post-tests scores of the control group.

Test	N	Mean	SD	df	t	P
Pre-test	25	6.6	1.258	48	11.099	0.00
Post-test	25	11.64	1.890			

As table 3 shows, the average pre-test score is 6.6 with a standard deviation of 1.258, whereas the average post-test score is 11.64 standard deviation 1.890 of the control group students who were learned by the LBE. It is seen that the average scores of the two groups are not close to another. The difference between the average pre-test and post-test scores of control group students is statistically significant [p=0.00<0.05]. Hence, the null hypothesis is rejected. Based on this result, their academic achievement was better in post-test performances.

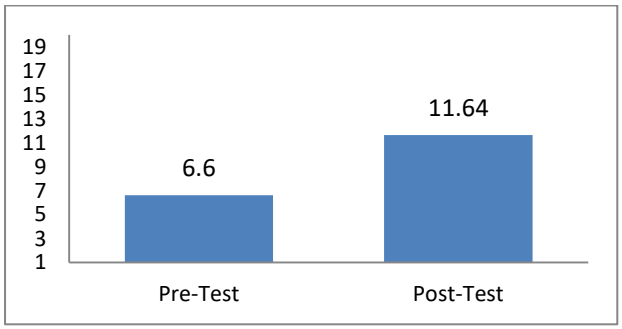

Figure 2: Graphical representation of Pre and Post-test mean scores of the control group analysis.

H_{02}: 2. There exists a significant difference in the academic achievement scores of experimental group students between pre and post-tests when the subject is learned through Blended Learning Environment (BLE)

Table no (4) refers to the analyses for testing the above hypothesis,

Table 4: The results of the t-test according to the pre and post-test scores of the experimental group.

Test	N	Mean	SD	df	t	P
Pre-test	25	6.76	1.052	48	18.42	0.00
Post-test	25	15.24	2.047			

As table 3 shows, the average pre-test score is 13.85 with a standard deviation of 1.052, whereas the average post-test score is 15.24 with standard deviation 2.047 of the experimental group students who were learned by the BLE. It is seen that the average scores of the two groups are not close to another. The difference between the average pre-test and post-test scores of experimental group students is statistically significant [p=0.00<0.05]. Hence, the hypothesis is accepted. Based on this result, it is inferred that students' academic achievement is higher in post-test than pre-test scores.

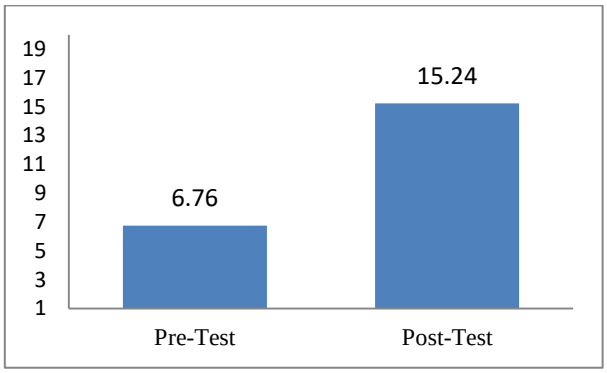

Figure 3: Graphical representation of Pre and Post-test mean scores of the experimental group analysis

H_{03}: 3. There is a significant difference in the post-test performance between the control and the experimental groups of students.

Table no (5) refers to the analyses for testing the above hypothesis.

Table 5: The results of the t-test according to the post-test performance between the control and experimental groups.

Group	N	Mean	SD	df	t	P
Control	25	11.64	1.89	48	6.460	0.00
Experimental	25	15.95	1.395			

It is evident from the table (4), the average post-test score of the control group is 11.64 with a standard deviation of 1.89, whereas the experimental group is 15.95 with standard deviation 1.395. It is seen that the average scores of two groups are not close than another. The difference between the average post-test scores of both control and experimental groups are statistically significant [p=0.00 < 0.05]. Hence, the hypothesis is accepted. Moreover, the academic achievement of the experimental group students is higher than the achievement of the control group students.

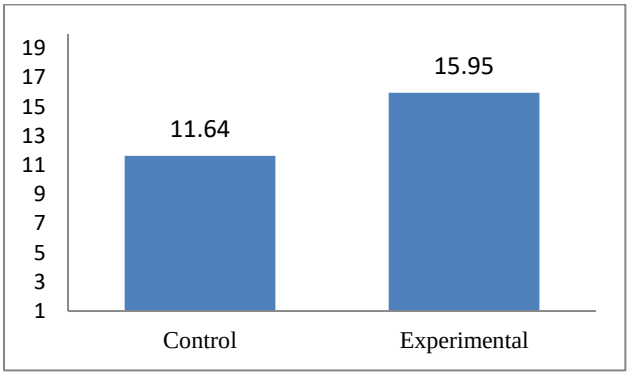

Figure 4: Graphical representation of post-test mean scores of the control and experimental groups analysis.

H_{04}: 4. There is no significant difference in the mean gain scores of the experimental group in terms of gender. Table no (6) refers to the analysis for testing the above hypothesis.

Table 6: The result of the t-test according to the mean gain scores of the experimental group in terms of gender.

Variable	N	Mean Gain	SD	df	t	P
Male	13	8.923	1.498	23	1.773	0.0896
Female	12	8.000	1.044			

As table 5 shows, the mean gain score of male students is 8.923 with standard deviation 1.498, whereas the mean gain of female students score is 8.000 with standard deviation 1.044 of the experimental group students who were learned by the BLE. It is seen that the mean gain scores of the two groups are close to another. The difference between the mean gain scores of experimental group students is statistically not significant [p=0.0896>0.05]. Hence, the null hypothesis is accepted. Based on this result, it is inferred that there exists no significant difference between the gain scores of the experimental group in terms of gender.

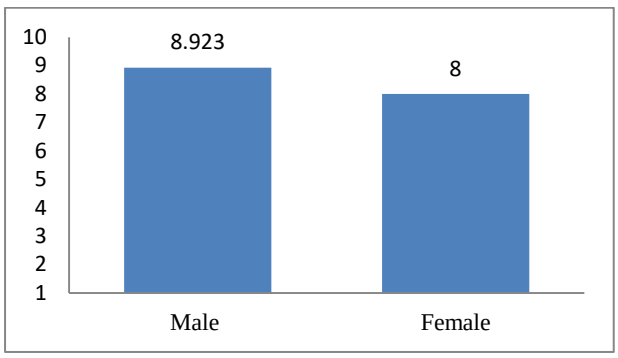

Figure 5: Graphical representation of mean gain scores of the experimental group in terms of gender analysis.

C. Gap Closure Analysis

Gap closure denotes that the percentage of the gap covered (after the experimental treatment) as specified by the distance between post-test and pre-test mean scores. The gap closure points out to what extent which treatment has been effective.

Table 7: Gap closure analysis of BLE and LBE

Group	Teaching Method	Pre-test Mean	Post-test Mean	Gap Closure %
Control	LBE	6.6	11.64	27.39
Experimental	BLE	6.76	15.24	46.49

From table 6, reveals that the gap closure percentage of the control group is 27.39 and the experimental group is 46.49. The gap closure percentage of control group shows a low percentage of gain scores, whereas the gap closure percentage of experimental group shows a higher percentage of gain scores. From the analysis, BLE is more effective in enhancing academic achievement in physics than LBE.

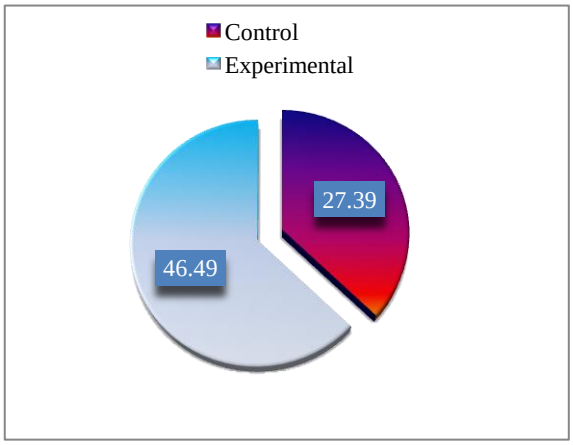

Figure 1: Graphical representation of gap closure analysis.

V. DISCUSSION

The t-test analysis of the difference in the pre-test means values of control and experimental groups is not significantly differ [p=0.6279 > 0.05]. Thus, the homogeneity of the group was established before the treatment. It can be said that the academic level and the readiness toward course are equal for the students both in the control and experimental groups. A few other studies Vimalkumar & Sivakumar, [19], Yildiz, & Ocak [14], Sivakumar [5], and Sivakumar & Selvakumar [11] are supporting this similar finding. From table 3, the difference between the average of pre and post-tests performance scores in terms of academic achievement of the students who learned through the LBE is found statistically significant [p=0.00 < 0.005]. It is concluded that the post-test performance scores are statistically higher than the pre-test performance scores in terms of control group academic achievement. It is evident from the table 4, the difference between the average of pre and post-tests performance scores in terms of academic achievement of the students who learned by the LBE is found statistically significant [p=0.00<0.005]. The findings revealed that the post-test performance score is statistically higher than the pre-test performance scores in terms of control group academic achievement. Based on the above two findings, academic achievement scores of the two groups are not similar between the pre and post-tests that significant difference has been found. These results show that the two different learning strategies (BLE & LBE) are efficient in terms of the academic achievement of students. Comparatively, experimental group mean difference (8.48) is greater than the control group mean difference (5.04). Hence, it is concluded that when compared to the LBE, the BLE is more effective in terms of academic achievement. The finding agreed with that of Vimalkumar & Sivakumar, [19], Sivakumar, [5] and Sivakumar & Selvakumar [11] studies. The study further revealed that the difference between the average post-test academic achievement of the students who learned based on two different learning methods is found statistically significant [p=0.00<0.05]. The academic achievement of the students in the BLE is statistically higher than the ones in the LBE. The finding of the study was found to be the similar result with that of research by Acelajado [12], Saritepeci [13], Yildiz & Ocak [14], Sivakumar [5], and Sivakumar & Selvakumar [11] which were conducted by utilizing blended learning environments. Hence, it is vital to utilize BLE which increase the academic achievement of students. The analysis of null hypothesis four showed that the difference between the mean gain scores of the experimental group in terms of gender who learned BLE is found statistically not significant [p=0.0896>0.05]. Hence, it is concluded that the academic achievement level of male and female students exhibited same level in learning physics at Diploma basic Engineering level and there is no gender influence. This finding is consistent with the studies Elian and Hamaidi [20], Selvakumar & Sivakumar [11] who explored that no statistically significant differences in the means on the academic achievement attributed to gender variable.

A. Research Implications

The research implications of this study as follows:

- The results of the study found that the BLE is more effective than the LBE in enhancing academic achievement in physics at Diploma in Basic Engineering level. Hence, it is recommended to adopt Blended Learning Strategies in teaching-learning of physics at Diploma in Basic Engineering level.
- Blended learning is an effective tool for teaching-leaning process to enhance achievement in physics. The AICTE and DoTE may insist on the lecturers in developing and implementing the blended learning strategies in their classrooms.
- The government and AICTE should prepare the scheme to promote blended learning methodologies in technical education level. For example, providing training and workshops to educators and administrators. They should afford enough funding for implementing innovative blended learning environments.
- Educators, policymakers and government authorities can seek for the network with international organizations for the opportunity of exchanging knowledge and the best practices form other countries that have successfully implement this approach.

- More researches should be done to consider application and accessibility of resources and as well as add-on technical supports to make ensure effective and successful implementation of blended learning.

VI. CONCLUSION

The main purpose of this study is to investigate the impact of the blended learning environment on students' academic achievement in Physics among Diploma in Basic Engineering Students. The study results revealed that students who were learned through BLE got higher scores in the academic achievement test than students who were learned through LBE. The study findings encourage lecturers of Diploma in Engineering to teach students through Blended Learning Strategies as it improved the students' academic achievement. Further, the findings insist on preparing pre-service teachers to have suitable training to use novel teaching strategies raised from both recent technological development and techno - pedagogical development to cater the needs of the new generation learners.

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