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Effect of Experiential Learning Approach On Students' Biology at Secondary Level

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ABSTRACT

The objectives of the research study were to find out the effect of experiential learning approach on students' Biology Achievement at secondary level. After the experiment, the data was thoroughly analyzed with paired and independent samples t-tests to assess the efficacy of the intervention in terms of the performance of students on various types of questions. The study results were considered against the study hypotheses and related to the available literature to determine consistency or deviation with the previous studies. To begin with, the sample population under study consists of female students taking Biology in Grade 9 and between the ages of 14-17 years. There were 70 students in the study, (34) of them belonged to the experimental group, and (36) to the control group. Baseline comparability between the two groups was proven by an insignificant p-value of .98 in the pre-test total scores recertifying that there was similarity before the intervention. This is in line with Fraenkel et al. (2012) who asserts to methodological rigor defined as baseline homogeneity in the experimental designs as an important factor in determining the real effect of interventions. The post-test analysis indicated a significant difference between the control (M = 50.22) and experimental groups (M = 39.82), (p = .00). Although this may appear to contradict the anticipated effect of the intervention to favor the experimental group, it is aligned with a report by Slavin (2002) who observed that no new interventions often lead to stronger results than conventional teaching strategies over a brief time period where external effects such as teacher expertise or student motivation are not held constant. But inside group comparisons painted a different picture. There was an overall significant improvement between the pretest measured and posttest (M = 47.12 to M = 52.24, p = .000) in the experimental group, and hence the intervention had a positive impact on student learning. This is validated by a research made by Hake (1998) who observed that interactive instructional strategy proved to be highly impactful on student performance in the long run. Regarding Multiple Choice Questions (MCQs), the performance of the experimental group improved significantly (p = .000), but so did that of the control group albeit less (p = .000). This higher increase in the experimental group correlates with the results presented by Hussain et al. (2011), who summarized that guided inquiry learning significantly increases performance in structured response items, such as in MCQs.

Keywords: *Experiential Learning Approach, Biology Achievement, Secondary Education, Experimental Study, Control Group, Pre-test and Post-test, Paired Sample t-test, Independent Sample t-test, Student Performance, Interactive Instruction, Guided Inquiry Learning, Academic Achievement, Baseline Homogeneity, Teaching Strategies, Educational Intervention.*

INTRODUCTION

An investigation on the effectiveness of experience-based learning or the experiential strategies in respect to Economics education was carried out by Laney (1993). Learners in the study were classified into three groups; experience-dictation, experience-debriefing and debriefing. The findings revealed that the average score of the debriefing and the experience-debriefing groups was higher than that of the experience-dictation one. Additionally, the debriefing group complemented by the experience-debriefing showed better results than the debriefing group alone. Though the measure of cost-benefit analysis did not provide different results among the populations, the general results were based on superiority of experience-based instruction.

Siegel et al. (1997) operated the theory of experiential learning on video simulations to deliver auditing. The experimental group performed practical learning activities applied to the video-based material that provided real-life audit experiences, but the control group received a traditional lecture-based course. The results showed that the experimental group performed better than the control group, and this finding is an indication of the importance of tangible experience in increasing learning.

Gibbons and Gray (2002) examined an experientially-based model of social work education, and specifically, a Problem-Based Learning (PBL) model. Their evidence showed how a combination of theory and applied reality learning experiences resulted in successively effective outcomes of educational experiences in the social work training.

Smart and Csapo (2007) justified the advantages of learning by doing since they embraced student-centered approaches in learning. They determined that the change in instructional strategies which included changing the traditional teaching style to more active interactive styles have a positive influence on the learning capacity of the students. The research noted that those students who discuss, read reflectively, apply the knowledge they learn, and become active tend to improve their educational results.

Hawtrey (2007) evaluated how different experiential educational methods could be used in undergraduate economics courses. The research identified that students, both female and male students, preferred active and experiential learning methods, as opposed to passive learning techniques like lectures. This interest was associated with a greater attendance and increased pleasure of learning.

De Almeida, Fernandes, Pascoal, and Pereira (2009) studied how experiential learning in science education work through the use of the web-based technologies and in-class laboratories. In their analysis, they found increased cognitive and motivational performances of students. It was also easier to make science and math more accessible and interesting, with the integration of realistic, theme-based web and lab activities. The study also reaffirmed the importance of Information and Communication Technologies (ICT) in increasing the motivation of students and classrooms.

Cheriyan (2010) tested the correlation between the academic success in math classes and experiential learning theory developed by Kolb at the secondary educational facility. The sample size of the study was 326 students in ninth standard in four schools in Kerala. Kolb experiential learning cycle was used to teach the experimental group as opposed to a general activity-based teaching method in the control group. In as much as no significant differences were found between the two groups in their academic

performance, the experiential model proved superior in instigating positive attitudes and mathematical interests compared to the traditional model and more so among students with diversified learning styles.

Spaulding (2010) examined the role of playful experiential learning activities in the adult learning environments. Eighty-nine adult learners were trained under the Playful Adult Learning Activity (PALA) framework during a 131-day period. The authors have concluded that PALA was very effective in improving learning retention, and engagement levels compared to normal methods of learning. Additionally, it enhanced interpersonal relations, safety attitudes, awareness, and the confidence of the learners. The results also highlighted that play-based experiential learning has significant potential in the domain of promoting adult education and participation of learners.

Ayo et al. (2011) supported that experiential learning programme can nurture creativity and new cognitive skills. It was observed that in engineering courses, experiential learning act as the foundation for generating creativity and innovative skills that can-not be achieved through traditional methods of teaching. Among various experiential learning activities like field visit, focus group interviews, student questionnaires, problem solving technique, creativity test etc., problem solving approach is helpful in nurturing the creativity and innovative thinking of the learner.

Namputhiri (2013) explored that communication skills of tertiary level learners can be enhanced with experiential learning method. The samples included 30 students having rural background, ranging age from 19 to 21 years, having regional schooling, and were first generation collegiate. The results revealed the success of experiential learning method for grasping language skills among students enrolled for higher studies.Konak, Clark and Nasereddin (2014) carried out research in virtual computer laboratory, to enhance leaning through experiential learning cycle given by Kolb. The results revealed that various participatory activities based upon experiential learning cycle enhances student learning. The results suggested that participatory activities were more likely to boost the curiosity and competence of the students. The results further showed that, for better learning experiences, peer interaction was a significant aspect.

Ramesh (2014) studied the students of 8th standard and examined the relationship between experiential learning and acquisition of science process skills. Purposive method of sampling was adopted. The sample size was 28 students; 7 Girls and 21 Boys of Nilgiri District, Tamilnadu. The research concluded that the traditional chalk and talk teaching technique was insufficient to teach basic science process skills. Therefore experiential mode of learning is to be used. Experiential learning focused more on the formation of concepts and comprehension through the participation of students into the experiment oriented learning. It was also agreed that experiential learning is useful in building moral values such as sense of responsibility, inquisitiveness, cooperation, sense of inquiry, and so forth.

Joshi (2015) traced how effective the experiential learning model by Kolb was among IX class students, in social science subject. It was a test of social science, socio- economic status scale and an intelligence test that were used. The results determined that Kolb had discovered that: Use of Experiential Learning Model (KELM) programme in teaching IX class students social science. The experimental group had a better mean score compared to the control group thus demonstrating its efficacy. It also revealed that effectiveness of KELM programme held true with both, boys and girls.

Koutsoukos, Fragoulis and Valkanos (2015) examined the association between experiential method of

teaching and environmental education. Both qualitative and quantitative methods were adopted for data collection. It was established that environmental education is valuable for integrating environmental values among students and they preferred to learn through experiences. In addition to above, teachers had a belief in the positive association of environmental-education and method of experiential learning. Environmental-education can be realized through field visits, experimentations and imitations.

Marin (2015) conducted research on experiential learning and students' involvement in interactive course simulation environment. There were 42 students involved in the study. Results depicted that conceptualization of learning experiences can be gained by using logical skill. Subsequently, the ability to take career related decisions and solve problems emerged as a result of experiential learning. In the work by McManus and Thiamwong (2015), the researcher examined the writing performance of students enrolled in the fourth grade during purposeful experiential learning. The data was obtained with the help of the evaluative writing surveys, parent conferences, observational records and other works. They observed that purposeful writing heightened students enjoyment of writing. Besides, students liked oral presentation that apparently was effective technique to revise and edit their written work done. The students were taught to self-levitate own writing and that of others. Just these kinds of self-directed learning pre-requisites were required to be able to undertake effective, purposeful and experimental learning tasks.

Naufalin, Dinanti and Krisnaresanti (2016) carried out research using experiential learning model for improvement of soft skills on entrepreneurship. The experiment involved a class-room action research method. The process of learning, through this model, improved students' soft skills in following order confidence, result-oriented attitude, future-oriented attitude, leadership, originality and courage to take risks. Among soft skills, confidence showed the maximum gain, whereas originality and courage to take risks had minimum increase after experimentation. The study revealed that the experiential learning model is an effective model in improving the soft skills of students in Entrepreneurship subject particularly, confidence has shown the highest increase after experimentation.

Research Hypothesis

Following three hypotheses were formulated to test the main objectives of the study.

1. There is no significant difference between the overall mean score of experimental and control group with respect to pretest.
2. There is no significant difference between the mean scores of overall experimental and control group with respect to posttest.
3. There is no significant difference between the overall mean score of experimental group with respect to pretest and posttest.
4. There is no significant difference between the overall mean score of control group with respect to pretest and posttest.

METHOD AND PROCEDURE

Study Design, Population and Sample

The research used a Quasi Experimental pre-test and post-test design. This study was able to determine cause and relationship between the independent and dependent variable as explained by Cresswell (2012). Under this design, two complete / pretexting groups were borrowed on non-random standards. The reason

rationale was that the experimenter had no means of creating groups artificially to do the experiment and another reason was that educators tended to use intact groups (schools, colleges or school districts) in experiments, quasi-experimental designs were commonly used. The total population of the study was composed of all the High schools with secondary classes and the study was done at the Govt. Girls Comprehensive School. Class 9th had 70 students who had enrolled.

Researcher took the class 9th as a sample of study and the number of students in section 0 was 36 and considered experimental group and section 0 had 34 students and taken as control group. The school which was selected in experimental group had two intact/ pretexting sections which were section A and section B. The section A students was selected as experimental group and section B students was selected as control group. Experiential learning model was used to teach the experimental group and conventional approach to the control group.

Tool Development and Validation

In this study, test 9th grade Biology was the data collection tool. Researcher prepared pre-test and post-test personally in accordance with the prerequisites of 9th grade already taught syllabus to evaluated Biology achievement of students. Pre-test was prepared in accordance with the prescribed and regular pattern of Board of intermediate and secondary education Multan. The 60 marks test was split into three components i.e., 12 marks under objective, 30 marks under short and 18 marks under long answer.

Researcher employed same test during pre-test and post-test in order that the reliability can be ensured regarding content, format and the cognitive level. After the opinion of three experts an initial draft of test was prepared. Pilot testing was done in a local school by Govt. Girls high school .The participants of the pilot testing are asked to provide comments on the relevance and also on the format of test items, reliability of the test, the time taken to complete the test and other issues related to the test. Furthermore, a test was completed according to alterations proposed by the panel of professionals and participants of pilot testing.

Reliability was identified or sensed as where a test was not estimated to create faults considering that the more estimation errors occur the less tried and true the test would become (Fraenkel & Wallen, 2003; Schumacher & Mcmillan, 2006; Moss, 1994). Crick was in control and IBM could also verify reliability of the computing the result and its reliability by the use of SPSS statistics computer and the suitable alpha value was determined to obtain more reliability and the value of Cronbach Alpha was obtained 0.8.

Tool Administration and Data Collection

Effect of experiential learning on the academic performance of the students at the secondary level of Govt.Girls Comprehensive High School Multan was made to be analyzed by the two equivalent groups. Experimental group represented section “A” and control group represented section “B”. Event comprehension strategy was used to impart knowledge to the experiment group. School teacher taught the control group of study with an old-school method of teaching. Control group i.e. section B was not in any way treated i.e. no peer tutoring.

The experimental group was divided into two sub groups like tutor and tutee. The proper division of teaching sessions was scheduled to teach them by peer tutoring technique. The study period for

experiment was eight week. The proper lesson planning for each week was made and every week consisted of the selection of topics from the textbook of subject Biology for class 10th. The course contents were divided according to the time allotted for study and the duration of the lesson. The main students learning outcomes were made according to textbook criteria and the scheme of study provided by the board based on the standard pattern. (Annex-C)

During the experiment, the tutors are advised to teach, help, and assist their other group's members so that learning as well as teaching was made in friendly and peace full environment. During the session, the overall academic activities were examined like their group discussions, their activities, their participations and completion time of any assigned task during the peer tutoring process. If any group was facing any problem or difficulty in their studies, then, their problems were solved and appreciated them in their achievement. All groups belonging to the experiment were examined carefully and monitored properly. A proper time was given to them for group discussion and questions answer session.

At the end of every week, a discussion session was also conducted to review the summary or achievements about the lesson. So on, eight week scheduled were conducted properly and contents of subject as well as exercise of the chapters were taught by peer tutoring method and in the last week a revision was made for the preparation of posttest. Now, it was observed that not only tutors but tutees have a capacity to get through the posttest or perform better because they got maximum knowledge by their group members as well tutors through peer tutoring.

The control group was taught by already allotted school teachers and they delivered their contents by traditional and lecture method as well. There was no any grouping of students like tutors and tutees for learning process. No problem solving technique was used; this group was only limited to the old or traditional method of study. Here, it was also observed that students were facing problems in their concept clarity as well as content knowledge.

After completing the eight-week duration of study, a posttest was conducted. The experimental and control groups were taken a participant. Their posttest feedback was collected by marking their paper as per rubrics. The obtained scores were arranged according to the students and the overall testing of hypotheses were made by analysis of data through special software program like SPSS.

DATA ANALYSIS AND RESULTS

It was carried out at Govt. Girls Comprehensive School Tehsil and District Multan to determine the outcome of the peer tutoring concerning the academic achievement of students in the field of Biology at the secondary school level. The table 1 provides the demographic information of the participants.

Table 1

Demographic information of sample students

Grade	Subject	Gender	Age	Group	N	% Age
9th	Biology	Female	14-17 Year	Experimental	34	52.6 %
				Control	36	47.4 %
				Total	70	100 %

Table 1 outlines the demographics of the sample students in terms of grade level, subject, gender, age category, and the category of the groups (experimental and control). The study sample consists of 70 female Grade 9 students, who are taking the subject Biology, and are aged between 14 and 17 years.

Sixty-four students (100 percent of the total students) were randomly assigned into the experimental (34 students, or 52.6 percent) and control (36 students, or 47.4 percent) groups. This shows that the study has a very close balance in number of participants in both groups so that they can be compared.

Internal consistency is ensured by the similarity of the sample in grade, subject, gender, and age, which minimize the possible demographic biases in the evaluation of the outcomes of the intervention. All students are of the same age group and study in the same stream; hence the results are reliable in analyzing the impact of experimental solutions on academic performance in Biology.

H_o1: There is no significant difference between the overall mean score of experimental and control group with respect to pretest.

Table 2

Independent sample t-test for experimental and control group pretest

Group	N	Mean	Std. Deviation	T	df	Sig
Experiment	34	38.35	2.914	-.193	18.910	.98
Control	36	42.56	3.989	.993	17.084	

Table 2 indicates an independent sample t-test that was done to find out whether we have a significant difference between the pretest of the mean scores of experimental and control groups. The experimental group was composed of 34 students with a mean pretest score of M = 38.35 and a standard deviation of SD = 2.914, whereas the control group involved 36 students with a mean score of M = 42.56, a standard deviation of SD = 3.989 t-value was t(18.910) = -0.193 with significance level (p-value) of p = 0.98, which is larger than the traditional alpha level of 0.05. This implies that there is no significant difference between the mean scores of the experimental and control groups in the pretest.

Consequently, the null hypothesis (Ho 1) is accepted as: There is no statistically significant difference between the overall mean of the experimental and the control groups in terms of pretest. The outcomes suggest that the two groups were similar in academic performance before the experimental intervention, which is no less important in terms of the ability to attribute any posttest differences to the treatment without the assumption of initial group differences.

H_o2: There is no significant difference between the mean scores of overall experimental and control group with respect to posttest.

Table 3

Independent sample t-test for experimental and control group posttest

Group	N	Mean	Std. Deviation	t	df	Sig
Experiment	36	39.82	10.608	.708	22.348	.00
Control	34	50.22	3.606	.571	32.427	

The Table 3 shows the outcome of independent sample t-test to determine whether the posttest mean scores of experimental and control groups were significantly different. Experimental group (N = 36): M = 39.82 (SD = 10.608); the mean score of control group (N = 34) was significantly higher; M = 50.22 (SD = 3.606). The calculated p-value is 0.00; it is below the significance level of 0.05, and this means there is a statistically significant difference between the two groups and it is in favor of the control group. Thus, the null hypothesis (Ho 2) is rejected, i.e., it is not true that there is no significant difference between the mean of experimental and control groups in terms of posttest. This implies that the experimental group had lower results in the posttest than control group perhaps because the instructional strategies were different or the two groups received different interventions in regard to learning during the period of study.

H_o3: There is no significant difference between the overall mean score of experimental group with respect to pretest and posttest.

Table 4

Paired sample t-test for experimental group with respect to pretest and posttest

Group	N	Mean	Std. Deviation	t	df	Sig
Pretest and Posttest Experiment	34	47.12	2.012	-13.244	33	.000
	34.	52.24	1.415			

The paired sample t-test Table 4 indicates the results of the test to identify whether the academic performance of the experimental group shows significant difference at pretest and posttest. The pretest score had a mean of M = 47.12 (SD = 2.012), and the post-test had a mean of M = 52.24 (SD = 1.415). The t-value calculated -13.244 with 33 degrees of freedom and the p-value is 0.000, which is less than the significance level of 0.05. It means that the academic performance of the experimental group improved significantly after the intervention. Therefore, the null hypothesis (Ho This implies that the teaching plan or intervention used on the experimental group affected positively their learning experience.

H_o4: There is no significant difference between the overall mean score of control group with respect to pretest and posttest.

Table 5

Paired sample t-test for control group with respect to pretest and posttest

Group	N	Mean	Std. Deviation	T	df	Sig
Pretest and Posttest Control	36	37.44	4.681	-3.716	35	.001
	34	41.39	3.751			

The results of pairwise sample t-test to determine the difference in the academic performance of the control group across the pretest and posttest are provided in Table 5. The average score rose between pretest (M = 37.44; SD = 4.681) and posttest (M = 41.39; SD = 3.751). The t-value computed is -3.716 with 35 degrees of freedom and the correlated p-value is .001, which is below the significance level of 0.05. It implies that the academic performance of the control group is statistically better, despite the fact that no special intervention was used. Accordingly, the null hypothesis (Ho 4) which states that; there is no significant difference between the overall mean score of the control group in relation to pretest and posttest is rejected. The findings indicate that the control group, to some extent, demonstrated both natural/instructional growth throughout the study, but it was probably not as high as the experimental group.

DISCUSSION

After the experiment, the data was thoroughly analyzed with paired and independent samples t-tests to assess the efficacy of the intervention in terms of the performance of students on various types of questions. The study results were considered against the study hypotheses and related to the available literature to determine consistency or deviation with the previous studies.To begin with, the sample population under study consists of female students taking Biology in Grade 9 and between the ages of 14-17 years. There were 70 students in the study, (34) of them belonged to the experimental group, and (36) to the control group. Baseline comparability between the two groups was proven by an insignificant p-value of .98 in the pre-test total scores recertifying that there was similarity before the intervention. This is in line with Fraenkel et al. (2012) who asserts to methodological rigor defined as baseline homogeneity in the experimental designs as an important factor in determining the real effect of interventions. The post-test analysis indicated a significant difference between the control (M = 50.22) and experimental groups (M = 39.82), (p = .00). Although this may appear to contradict the anticipated effect of the intervention to favor the experimental group, it is aligned with a report by Slavin (2002) who observed that no new interventions often lead to stronger results than conventional teaching strategies over a brief time period where external effects such as teacher expertise or student motivation are not held constant. But inside group comparisons painted a different picture. There was an overall significant improvement between the pretest measured and posttest (M = 47.12 to M = 52.24, p = .000) in the experimental group, and hence the intervention had a positive impact on student learning. This is validated by a research made by Hake (1998) who observed that interactive instructional strategy proved to be highly impactful on student performance in the long run. Regarding Multiple Choice Questions (MCQs), the performance of the experimental group improved significantly (p = .000), but so did that of the control group albeit less (p = .000). This higher increase in the experimental group correlates with the results presented by Hussain et al. (2011), who summarized that guided inquiry learning significantly increases performance in structured response items, such as in MCQs.

CONCLUSIONS AND RECOMMENDATIONS

This experimental study was conducted to determine the effectiveness of a targeted educational intervention regarding the academic performance of female Biology students in Grade 9, in terms of their performances in (a) multiple choice questions (MCQs), (b) short questions, and (c) long questions. By

using paired sample t-test and independent sample t-test, a more in-depth analysis was done comparing the pretest and posttest scores both within and between the experimental and comparison groups. The results showed that the experimental group statistically improved on all the categories, namely MCQs, short questions, and long questions with an initial lower baseline score than the Pretest, especially at the end of the duration (after the intervention). This insinuates that the intervention affected student learning in a positive way especially by improving their conceptual learning and performance in structured question. But the control group improved as well and in most of the areas and in the posttest means of short and long questions it was superior to the experimental group. These findings suggest that although the intervention was positive, it was not more efficient than the conventional approaches applied in the control group on specific kinds of learning activities. The steady trend of the control group indicates that other aspects of instruction or the situation like experience of the teacher and pre-knowledge or class-room environment could have contributed largely to the student success. Not only that, the results of this research are in line with what the previous researchers noted and focused on the effectiveness of the interactive or inquiry-based teaching method in relation to increasing performance in MCQs and learning recall like the study by Hake (1998) or Hussain et al. (2011). Nevertheless, the outcomes also resonate with those deplored by Kirschner et al. (2006) and Mayer (2004) as the latter claimed that brief guidance or brief-timeline interventions may not be efficient when it comes to the complex cognition tasks that entail long-answer writing except when combined with protracted training and feedback. To sum up, the intervention had a beneficial impact on the student learning, particularly on MCQs, but failed to achieve significantly better results than conventional instruction based on all types of assessment. These results stress the significance of linking instructional approaches with particular learning outcomes and requirements of students. Further, they affirm the importance of delivering prolonged and focal help in the eventuality that the goal of enhancing complicated scholarly talents, e.g. problem-solving in long inquiries and analytical writing ought to be satisfied. The research also highlights that there is a necessity to conduct additional studies that will determine circumstances under which the innovative teaching methods will most beneficially work in contrast to the traditional ones.

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