P-ISSN: 2709-6254	Journal of Development and Social Sciences	Jan-Mar 2023, Vol.4, No.1
O-ISSN:2709-6262	http://dx.doi.org/10.47205/jdss.2023(4-I)49	[552-559]

Journal of Development and Social Sciences
www.jdss.org.pk

RESEARCH PAPER

Activity Based Teaching and Science Students' Academic Achievement at Secondary Level: An Experimental Study

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ABSTRACT

This study was intended to investigate the effect of activity based teaching on achievement of Physics students at secondary level. The pre-test, post-test control group design was used to conduct this experimental study. Two equal groups of 20 students in each were formulated through random assignment. The experimental and control groups were made on the basis of pre-test of academic achievement. Control group was educated through old way and experimental group was educated through activity based teaching. Paired Sample t-test was used to analyse the data. Conclusion included that there exists an important parameter in overall academic achievement of both groups shared through traditional method and activity based teaching. Students of experimental group gained significantly greater marks than control group students in their knowledge, comprehension, and application level of Bloom taxonomy.

KEYWORDS Academic Achievement, Activity Based Teaching, Physics, Secondary Level, Traditional Method

Introduction

Digital At university level teaching, lectures are usually an integral component. While as far as other teaching practices and techniques are concerned, lectures are considered comparatively of less importance regarding teaching learning process of the students (Phillips, 2005). Different structured teaching practices used in the teaching of Physics can be beneficial in many ways i.e. they can increase interest of students in this difficult subject also such practices are more fruitful regarding results as compare to traditional teaching. Lecture method has been a predominating way of teaching of science subjects at higher secondary school and at degree classes. But different researches point out that teaching practices other than lecture method are more beneficial for students (Deslauriers, Schelew and Wieman, 2011). Educational improvement means to develop such an atmosphere which facilitates to apply different teaching practices and experiences, so if we want educational improvement, we will have to modify the mind-set of the lecturers (Frielick, 2002). In teaching of Physics computer based method of instruction is considered as good as compare to lectures so studies are recommended in other fields of science (Hussain et al, 2014). Different names are given to this one concept of activity based teaching, i.e., hands on activities, experiential learning, learning by doing, and activity based teaching

Hands on activities consist of a variety of teaching strategies and practices. The central part is the demand that a learner should do some practical work in order to learn something. The core idea of hands on activities is that the students learn more through their active participation while they learn less without participating in the activities. If the students are well equipped with all necessary gadgets with proper guidance and conducive learning atmosphere, instructional procedure can be made more interesting and permanent. When learning is centred on activities, students are eager to learn and apply concepts that are pertinent to their needs. A method of instruction where students actively

participate in a variety of activities rather than passively listening to a lecturer in order to learn (Pine, 2012).

Learning is a positive change in behaviour. Learning means a comparatively long lasting change in attitude and cognitive domain and all these changes are the result of experiences (Santrock, 2011). National Education Policy (2009) emphasizes on technical and vocational education at all levels. Policy makers are also aware of the fact that schools do not have sufficient resources and infrastructure to fulfil needs for technical trainings. Professional and skilled staff for such trainings is not available. The curriculum does not meet the requirements of market. In the prevailing situation, it was scheduled to probe the effect of activity based teaching on learners' attainment.

Literature Review

Science helps us to understand different aspects of life. It is a systematic and organized way of searching the truth. Science as the branch of study deals with discovering, experimenting and observing. Noor and Rehman (2017) suggested that serious efforts are needed in science staff development, quality of textbooks, examination system and infrastructure development to bring change. For student retention in a classroom, stressing effective learning is essential. The instructors should be flexible to the evolving classroom atmosphere and understand the needs of the students if they want to enjoy the course and develop goals. Activity-based teaching, is a learning process in which pupils are continually participating, is one such technique, claims Panko (2007). Activity-based teaching deals to a situation when students take part in learning process as opposed to only being passive listeners. Churchill (2003) stated that activity-based learning encourages students and learners to develop intellectual representations that support higher-order performance, such as the use of information, skills, and problem-solving techniques. The systematic ideologies are informal for students to understand when these are educated through activities. For student retention in a classroom, stressing effective learning is essential. The teachers must adjust to the classroom's and the pupils' shifting needs. Students are well capable to put on their systematic cognizance in the array of real-world settings when they are dynamically contributing in the instruction, wisdom, and events. In activity-based instruction, the pupil participates in the instructive procedure during demo of 'doing' instead of in conservative practice (McGrath & MacEwan, 2011).

A teacher may employ activity-based teaching to emphasise their use of teaching by doing, in which case the students are fully involved and achieve effective learning approaches. In order to successfully engage the child, both physically and cognitively, in taking an interest. In a classroom, emphasising successful learning is crucial for student retention. The teachers must be flexible to the changes. Activity-based training is distinct from conventional teaching strategies, claims Kenly (2007). Elik (2018) found that scholars' theoretical performance and attitudes towards activities are both improved by activity-based learning activities. Moreover, activity-based learning approach creates the perfect environment for scientific instruction (Shah & Rahat, 2014).

Activity-based learning is a teaching method that keeps students occupied while they are being taught (Noreen & Rana, 2019). Activities based on real-world experience help students share their own knowledge that can differentiate in a variety of settings, according to Edward (2001). Hussain, et al. (2011) claim that activity-based learning is more effective than a conventional teaching strategy for teaching physics at the secondary level.

Null Hypothesis

H01: There is no change between students' scores when taught through the old style and teaching activity.

H02: There is no noteworthy difference in students' scores taught through old style and teaching activity regarding their knowledge level.

H03: There is no noteworthy difference between academic attainment of students taught through old way and activity based teaching regarding their comprehension level.

H04: There is no noteworthy difference between academic attainment of students taught through old way and activity based teaching regarding their application level.

Research Design

This was experimental study. Research-design related to pre-test post-test control group design. There were two sets comprising 20 students in each group participated in the research. These sets were named as experimental (treatment) group and control group. Old way was used to teach control group and activity-based teaching system was used to teach trial group. Secondary school students of science group of session 2022-23 of Govt. High School Abdal, Gujranwala were the population of this experimental study. All the 40 students of science group of class 9 were considered as sample of study. Random assignment was used to select experimental and control group on the bases of matching scores of students in pre-test of academic achievement test. Activity-based approach and traditional-approach of teaching were independent variables while students' academic achievement in the subject of Physics was considered as dependent variable of the study. The study continued for eight weeks. Twenty five lessons of Physics were delivered through activity based teaching method in twenty five periods to experimental group. These periods were taken on every Monday, Wednesday and Saturday of each week. Similarly, twenty five lessons of Physics were delivered through traditional lecture method in twenty five periods to control group. Each period was consisted of 90 minutes. These periods were taken on every Tuesday, Thursday and Friday of each week.

Instrumentation

Achievement test was administered to both group students before manipulation of treatment to the experimental group. Detail of items development is presented in the following table.

Table 1
Table of Specification

Sr. No.	Learning Level	No. of items	Marks	percentage
1	Knowledge based Items	30	30	40%
2	Comprehension based Items	25	25	33%
3	Application based Items	20	20	27%
4	Total	75	75	100%

To ensure validity of the academic achievement test, expert opinion was taken from ten subject matter experts of Physics and the educationists. Four items were excluded from the first draft of achievement test due to weak CVR. Necessary changes were made accordingly. After treatment, post-test of academic achievement was carried out.

Data Analysis

Collected data through achievement test was analyzed through SPSS. Screening of data was ensured after entering and coding the data in SPSS. Overall mean score relation with control and trial group in pre-test of Physics is discussed in the subsequent table.

Results and Discussion

Table 2
Comparison between overall mean score of control and experimental group in pre-test

Group	N	Mean	S.D.	M. D.	df	t-value	Sig. (2-tailed)
Experimental	20	33.50	5.22	0	19	-	-
Control	20	33.50	5.22				

Overall mean of experimental group (M = 33.50, S.D. = 5.22) is exactly equal to the overall mean of control group (M = 33.50, S.D. = 5.22). So it was not possible to compute P and t-value due to zero mean difference. So, it was decided that the presentation of the both group pupils in the subject of Physics was found similar which was evident that before the treatment these two groups were exactly equal to each other regarding their academic achievement.

Table 3
Comparison between mean-scores of experimental and control sets in knowledge level in pre-test

Group	N	Mean	S.D.	M. D.	df	t-value	Sig. (2-tailed)
Experimental	20	15.10	3.53	0.80	19	1.69	.11
Control	20	14.30	3.27				

Mean Score of knowledge level of experimental group (M =15.10, S.D. = 3.53) differed 0.80 with the mean score of knowledge level of control group (M = 14.30, S.D. = 3.27). Moreover, insignificant difference ($t(19) = 1.69$, $p = 0.11 \leq 0.05$) was found in the mean scores of knowledge level of both the sets on pre-test. This table showed that before the treatment both the groups were nearly equal regarding their knowledge level.

Table 4
Comparison between the mean scores of control and experimental group in comprehension level in pre-test

Group	N	Mean	S.D.	M. D.	df	t-Value	Sig. (2-tailed)
Experimental	20	11.60	2.25	0.4	19	0.89	0.38
Control	20	11.20	2.04				

Mean score of comprehension level of experimental group (M =11.60, S.D. 2.25) differed at 0.4 from the mean score of control group (M = 11.20, S.D. = 2.04). Moreover, insignificant difference was observed as ($t(19) = 0.89$, $p = 0.38 \leq 0.05$) the mean score of application level of both control and experimental group before manipulation of the treatment which showed that before applying independent variable, both the groups are approximately equivalent to each other with respect to comprehension level.

Table 5
Comparison between control and experimental group in application level in pre-test

Group	N	Mean	S.D.	M. D.	df	t-Value	Sig. (2-tailed)
Experimental	20	6.8	1.90	1.2	19	1.9	.074
Control	20	8.0	1.69				

Mean score of application level of experimental group (M = 6.8, S.D. = 1.90) differed 1.2 from the mean score of control group (M = 8.0, S.D. = 1.69). Moreover, there was found insignificant difference ($t(19) = 1.9$, $p = 0.74 \leq 0.05$) between mean-scores of both control and trial group on application level. It revealed that both the groups performed approximately the same on application level.

First hypothesis was about the difference between academic achievements of both group students. Paired sample t-test precisely used to investigate the change in academic achievement of the pupils educated through old approach and the activity-based teaching. The results were compared on post-test which are presented in the subsequent table.

Table 6
Difference between mean gain scores of control and experimental groups on post-test

Group	N	Mean Gain	S.D.	M. D.	Df	t-Value	Sig. (2-tailed)
Experimental	20	28.45	6.4	24	19	13.52	0.00
Control	20	4.45	6.8				

Table 6 showed the results of comparison between academic achievement of control and trial group students. Mean gain score of experimental group (M = 28.45, S.D. = 6.4) significantly differed from the mean gain score of students taught through traditional method (M = 4.45, S.D. = 6.8; t(19) = 13.52, p = 0.00 < α = 0.05). On the basis of these findings, the null hypothesis H01 was rejected. It was decided that pupils educated with the help of activity executed well as compared to the students educated through old method. Moreover, magnitude of difference was also found high as effect size was found as 3.02.

Second hypothesis was about the change between mean gain scores of control and trial group students' academic achievement on comprehension level. To test the hypothesis, paired sample t-test was applied and the outcomes are presented in the subsequent table.

Table 7
Comparison between mean scores of control and trial group on students' knowledge level

Group	N	Mean Gain	S.D.	M. D.	df	t-Value	Sig. (2-tailed)	Effect Size
Experimental	20	12.7	3.5	9.85	19	10.37	0.00	2.31
Control	20	2.85	3.4					

Table 7 showed the evaluation of the mean gain of control and trial sets of students' achievements on knowledge level. Results showed that academic achievement on comprehension level of experimental group students (M = 12.7, S.D. = 3.5) significantly differs from the academic achievement of control group students (M = 2.85, S.D. = 3.4; t(19) = 10.37, p = 0.00 < α = 0.05) on post-test. On the basis of these findings it was concluded that the null hypothesis H02 was rejected. Moreover, mean gain scores showed that the performance of experimental group better than control group students educated through old method. Magnitude of difference was computed and the effect size was found high as the value of effect size = 2.31. Next hypothesis was about the difference between mean gain score of students' academic achievement on comprehension level taught through traditional and experimental method. Results are presented in the subsequent table.

Table 8
Comparison between mean scores of control and trial group on students' comprehension level

Group	N	Mean Gain	S.D.	M. D.	df	t-value	Sig. (2-tailed)
Experimental	20	7.55	3.41	6.65	19	9.93	0.00
Control	20	0.90	2.53				

Table 8 demonstrated that mean gain score of students' academic achievement on comprehension level of experimental group (M = 7.55, S.D. = 3.41) significantly differed from control group (M = 0.90, S.D. = 2.53; t(19) = 9.93, p = 0.00 < α = 0.05). On the basis of

findings null hypothesis H03 was rejected because there was contrast between the academic achievements of both sets of students. Moreover, degree of the change was calculated, and the effect size was found 2.22 as large. The last hypothesis was about the variance in mean gain scores of control and trial set on application level. Results are presented in the subsequent table.

Table 9
Contrast between mean scores of control and experimental group on students' application level

Group	N	Mean Gain	S.D.	M. D.	df	t-Value	Sig. (2-tailed)
Experimental	20	8.2	2.16	7.5	19	7.89	0.00
Control	20	0.7	2.7				

Table 9 shows that t-value = 7.89 with df = 19 was found significant as $p = 0.000 < \alpha = 0.05$. Hence, the null-hypothesis H04 was rejected. It was concluded that there had been an important changes in between mean gain scores of students' academic achievement on application level taught through traditional method and activity-based teaching. Mean scores showed that experimental group (M = 8.2, S.D = 2.16) performed better as compared to control group (M = 0.7, S.D = 2.7) on application level in Physics. Magnitude of the difference was computed using effect size. Value of effect size = 1.76 showed that strength of difference is large.

Discussion

This study was intended to draw out the influence of activity-based instruction on Physic students' academic attainment. Academic achievement test developed aligned with the three basic levels of Bloom taxonomy i.e., knowledge, comprehension, and application. Findings of the study revealed the most important cause of activity-based teaching on students' knowledge, comprehension, and application level in Physics. Moreover, there was found noteworthy change between academic attainment of pupils educated via activity and old way in the subject of Physics. Results of the study are aligned with the study conducted by Kenly (2007). Moreover, results also supported by the findings of Hussain et al. (2011) that teaching Physics with activity based teaching is more successful.

Conclusions

Following conclusions were extracted by keeping in view the findings of data analysis.

1. "Activity based teaching method" is more effective as compared to old method of instruction for 9th class students to teach them Physics.

2. "Activity based teaching method" improves knowledge level of 9th class students as compared to old method of instruction in teaching Physics at secondary level."

3. Activity based teaching method improves comprehension level of 9th class students as compared to traditional way of instruction used to teach Physics.

4. Activity based teaching method improves application level of 9th class students as compared to traditional method of teaching in the subject of Physics at secondary level.

Recommendations

On the basis of conclusions of the study, it was recommended that activity based teaching method may be encouraged at secondary level particularly in science subjects to condemn rote learning. Moreover, activity based teaching method may be included in different training programs and refresher courses especially for science educators. Furthermore, it was also recommended that different activities related to the course outlines may be included in the curriculum to enhance the interest of the students according to their age level. Additionally, science labs of the schools may be well organized, furnished and functional in all aspects to carry out the activities related to practical work.

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