Effectiveness of Activities in 10th Grade Physics Curriculum on The Achievement of Students in District Pakpattan

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Abstract
The aim of study was to investigate the effectiveness of activities in 10th Grade Physics Curriculum on the Achievement of the Students in District Pakpattan. The main objectives of the study were, to assess the understanding of secondary school students in basic concepts of Physics, to investigate the role of activities in concept development in Physics, to explore the effectiveness of activities in secondary school Physics on the academic achievements of the students and to compare the effects of traditional method and that of activities in secondary school Physics on academic achievements of students. Post-test only Control Group Design of experimental research was selected for this research study. All the science students of 10th Grade at Secondary level of English Medium Govt. High Schools and Higher Secondary Schools for Boys of District Pakpattan constituted the population. Sample of the study comprised of randomly selected students of two high schools. The t-test was used to analyze the data statistically. It was recommended curriculum of Physics should be developed in such a way that activities should involve in each topic to decrease the difficulty level of students at secondary level.
Keywords: Activities. Physics Curriculum, Secondary Level, District Pakpattan

Introduction
The learning through activities develops the confidence of both the learners and the teachers. Harfield, Davies, Hede, Panko and Kenley (2007) believe that as a result of activity-based learning; students lively participate in the learning process instead of sitting passively on their benches. Activity-based learning has unbreakable relation with the cognitive learning.

Stoblein (2009) points out that in activity-based learning, the teacher has to organize the situations that demand students to work in groups and pairs and discuss the problem in a meaningful way. In activity-based teaching the teacher's role changes drastically. Instead of becoming a sage on the stage, he becomes a facilitator and motivator who encourage the students to discover the new ideas in their own way (Stoblein, 2009).

This technique is a child centered approach in itself. Limbu (2012) stresses that the more a conception is visited through different senses the more it becomes comprehensible so it is important that the integration of all senses is ensured in the understanding of a problem. Learning by doing, according to John Dewey (1938) is that children develop their understanding of concrete concepts by their own experience and doing under the proper guidance of teacher in a conducive environment. According to him, true education comes only when social situations demand the learners to utilize stimulation to cope with the problem in which he found himself.

In ABT (activity-based teaching) learners interact the things by their own willing and implement those concepts which are relevant to their desired needs (Pine G., 1989). So, any learning which is carried out by physical involvement stimulates for creativity or expression by using their solid mental actions according to the requirement in a social environment will be meaningful for learning process. In order to make the learning process more successful there should be continuous interaction between the activities and the learners. Actually it is not so easy to find out how active learners act in the learning process and how they should take the responsibility for the construction of knowledge by using their attitudes and gain required learning experiences according to the requirements (Bonwell & Eison, 1991).It is always complained by majority of the learners that they come in classroom with lack of ideas about different concepts. They are applying the same previous routine without any new creative idea. For taking any type of information from educators, learners will engage themselves as active learners for problem solving by using reading, writing and discussions (Bonwell & Eison, 1991; Litecky, 1998; Prince, 2004). Active learning is a social constructive approach for higher learning. This learning can either take place in groups or self-directed (Chermak & Weiss, 1999; Prince, 2004). For this, we must adopt communicative approach in which all the activities must develop skills in the learner by following the official program in those contexts. The teacher should apply constructivism methodological approach which allows the learners in the construction of knowledge by their self-contribution in the learning process. This type of approach emphasizes that the leaner must use their senses for the construction of new knowledge that should be maintained for the long time (Syh-Jong, 2007, Tobin &Tippins, 1993).

Literature Review

Science and technology are playing an undeniably important role in the present world scenario. It is important for the learner to find out the practical use of scientific knowledge of the concrete world to play his or her real effective role in the science driven world (Millar, 2004).

Science education

There is need to use such teaching learning strategies and techniques that will help in understanding scientific phenomenon and involve the learning of scientific concepts (Ainsworth, 2006). Bell, Blair, Crawford and Lederman (2003), emphasize that to impart effective science education teachers themselves should have a very clear-cut idea of the principles of scientific inquiry. The study of Shamos (1995) found that the scientific way of understanding things helps the pupils to be better and daring decision makers and their problem-solving abilities are better than the common people. Studies conducted by Cobern and UNESCO (1994), National Research Council (1996) and Bajah and Oversby (1998) conclude that the real goals of science education should be to make learners creative, improve the level of scientific literacy, to develop in them the scientific awareness about the aspects of life, to enable them to contribute actively to the development of their culture and to inculcate the spirit of scientific thinking in them.

Importance of Physics in Science Education

Among science subjects, Physics is considered to be the most challenging for students. Generally, at the initial stage you face some difficulties in some concepts but the reward will be fruitful for the satisfaction of the learners (O'Keeffe, 2009). According to Ronald (2001) "the real text of physics is the physical world. If the students are not actually doing something, which includes active thinking then the student probably is not learning." To create an attraction towards the subject of physics, we need to create small, easily conductible activities at secondary level, so that students can better understand and learn the subject.

Learning Science as an Active Process

Active learning is oppositely used to passive learning (Murray & Brightman, 1996). This process engages the students more deeply in learning and it helps to retain the things in the mind on longer basis for the things found firmer roots in the long-term memory (Stephen, 2006; Smyth, 2009; Hur& Suh, 2012). They kindle intrinsic motivation in students to master the things that they are learning that is the most important requirement for meaningful life-changing learning (Bork, 2000; Bilda, Candy, & Edmonds, 2007; Liang &Seding, 2009).

Methods of Science Teaching

Teaching strategies have been an important element of any educational system. Walberg (2003, p.47) an internationally respected educational psychologist, renowned for his work compare elementary and secondary educational system in different countries. We can divide these methods into two categories

i. Teacher Centered Methods of Teaching
ii. Student Centered Methods of Teaching

Teacher Centered Methods of Teaching:

The most remarkable method of history which is still in practice in developing countries is traditional method i.e. lecture method. In this method verbal presentation of the topic is done by the teacher to the learners. It is also called Socratic Method. In this, students are unable to engage themselves in different problem solving activates. They can't apply achieved knowledge and skills in actual life events. "Numerous studies were conducted in developing countries to stress the facts that science teaching is seldom linked to the developing of thinking skills related to solving real problems"(Caillods, Duret& Lewin, 1996).

Student Centered Methods of Teaching

Dupiant- Bryant (2004) points out that the learner centered teaching is a style, in which instructions are given in such a way that these will be sharing of ideas among themselves, focus on problem and democratic in learning. This teaching style plays an effective role for improving motivation, understanding of the learner in every type of learning democratically (Liu, et. al.,n.d.).

Teaching of science has been recommended by many researches by a pedagogy that will support inquiry based, hands on teaching using mental abilities. This strategy is accepted only at ideal level dominated by lecture methods in Pakistan. That is why our level of learning is low. This should be minimized by giving more attention on that learner will be focused all of our educational activities (National Curriculum of Biology, 2006).

There are different methods which may get theoretical supports from constructivism; some of them are as follows;

i. Lab based teaching method
ii. Inquiry based teaching method
iii. Activity based teaching method

Lab Based Teaching Method

In this method, the teacher use laboratory for his teaching which refers to practical work. Practical work, experiments or laboratory work and hands on activities all are related to perform practical with science apparatus in the laboratory (Woolnough, 1991). Without practical the science learning is similar to swim without the water (Score, 2008). Activities of laboratory may be of different categories that play crucial role in the curriculum of science. Teachers point out that a lot of benefits can be achieved to engage the learners in the activities that will be performed in science lab (Hofstein and Lunetta, 1992). Tobin (1990) suggested that performing activities appeal the learners to understand difficult concepts in laboratory setting. In this process the learner constructs their own required knowledge by doing science.

According to Tobin (1990), (as cited in Hofstein , 1992), research is compulsory to check the effectiveness of science lab for teaching and learning. The main purpose of laboratory activities is to take control of their own learning in the quest of conceptual learning. For this, it is essential for the teachers that they should arrange the opportunities for learners in which the students to moot out questions, make assumptions and investigate them by manual activities using mental abilities for learning (Gunstone, 1991).Learners begin to understand the real world by using all their senses and get clear observation about natural phenomena if they directly work with it (Board of National Science, 1991, p. 27 as cited in Haury, 1993).

Inquiry Based Teaching Method

In teaching through inquiry method, the environment of the classroom should be created in such a way in which the learners are engaged in learning through doing by hands, students focusing performance in open-ended activities (Colburn, 2000). In this method, students are involved in students centered activities and these activities should be open-ended and hands-on. Inquiry also engages the students in such types of activities, in which they construct their own required knowledge, develop the understanding about new scientific concepts. So in this way they get the idea, how scientists involve themselves in the study of real world happing (National Standards of Science Education, 1996).

Inquiry will give identification to hypothesis through logical thinking. In this, we consider the alternate thinking for the solution of problems (NRC, 1996 as cited in Hofstein & Lunetta). In Inquiry, we involve the learners in different types of problems in different contexts. During this, the learners struggle to find out the solution of those problems to learn and understand the basic facts. “Inquiry is a way in which people learn when they are left alone” (Schuman, 1996).

Inquiry based teaching method makes the student’s active participants and this method is extensively used in physics education (Alexander, 2001 as cited in khan, et.al, 2011). Students of science should be engaged in such context that we can provide them a chance of using scientific inquiry. Haury (1994) suggested that the inquiry involves activities, skills by focusing on research for the satisfaction of their anxiety.

Activity Based Teaching Method (Activity Based Teaching and Activity Based Learning)

ABT and ABL, both are involved in activity method. The term activity is defined as anything that is done in the social environment by the interaction among physical and mental abilities (Kochhar, 1986). Subirshukla (2011) defines activity as, “A challenging experience that engages the child’s mind in purposeful learning. The key is to create a context that presents a challenge, invites the child into learning." So, the key concept of activity is that it incites the learner on learning.

According to Lumpe and Oliver (1991) activity-based hands-on learning is, any activity which is done in lab setting allowing the learners to handle and observe the scientific process. By this definition we conclude that in ABL students interact with different types of materials to perform the hands-on activities. In this, learner is actively involved in learning process which causes in overall improvement in behavior and drop out problem decreases (Parker and Heywood, 2002).

Objectives of Study

1. To assess the understanding of secondary school students in basic concepts of Physics.
2. To investigate the role of activities in concept development in Physics.
3. To explore the effectiveness of activities in secondary school Physics on the academic achievements of the students.
4. To compare the effects of traditional method and that of activities in secondary school Physics on academic achievements of students.

Hypothesis

H_o 1: There is no significant effect of activities recommended in secondary school Physics on students' understanding of basic concepts of Physics.

H_o 2: There is no significant effect of activities recommended in secondary school Physics on academic achievements of students.

H_o 3: There is no significant difference between performances of students taught with activities and those taught without activities.

Methodology of the Study

Research Design

The nature of the research was experimental. For this purpose, the researcher adopted post -test only control group design for this research. In this, control and experimental groups were formed. Board result of 9th class was taken to equate the groups while researcher himself prepared six posttests which were validated by a team of experts.

Population

All the science students of Boys Secondary Schools and Higher Secondary Schools in District Pakpattan, studying the subject of Physics in 10th Grade, constituted the population (Total students: 4340)

Sample of the Study

There were 63 Secondary Schools and Higher Secondary Schools in District Pakpattan. Randomly two high schools were selected. Students studying physics in 10th grade of one school were randomly assigned to experimental group while students of other school were assigned to control group.

Table 1: *Sample of the Study*

Groups	Numbers
Control Group	25
Experimental Group	25
Total	50

Tools of Research

Following tools of research were developed by researcher:

Planned Activities

Twenty activities were planned by the researcher for experimental group from first six units from fifteen topics of 10^{th} Grade Physics.

Post-test

Six chapters were selected to investigate the effects of activities on the development of concepts included in those chapters. Therefore, six posttests were developed based on the concepts discussed in those chapters. Each test was based on one chapter. First five steps of Bloom's taxonomy i.e. Knowledge, Comprehension, Application, Analysis and Synthesis were incorporated in post-tests. Content of tests was validated by a panel of experts.

Validity and Reliability

Content of tests was validated by a panel of experts. The researcher calculated the reliability of post-tests with the help of Spearman's Brown formula. Split-Half Coefficient) was 0.932 which shows that the tests are highly reliable with high internal consistency.

3.5 Procedure of the Study

With the permission of school authorities, study for three months was conducted. First of all, on the basis of Board result of 9th class, control group and experimental group were equated.

Table-2: Independent t-test for control group and experimental group

	Mean	N	Std. Deviation	t	Df	Sig. (2-tailed)
Control Group	14.96	25	4.057	.563	24	.579
Experimental Group	14.24	25	5.142			

α = .05

In table-2, the observed p-value [t (24) =.563, p=.579] is greater than. 05, which is not significant. So the two groups are not significantly different in achievement.

After equating the groups, the researcher taught 15 topics to experimental group through activity based method. Each activity was taught and performed in a separate period (one period for each activity) and was done by researcher by teaching the whole unit in a routine work according to the time table. In activity based class room, the researcher spent first 5 minutes for introduction to the topic, during the next time period (25 minutes) the researcher performed the activities and inferred results from those activities. After experiment, the researcher facilitated the students to perform those activities and inferred the results. While control group was taught through traditional lecture (chalk and talk) method without performing activities by subject teacher.

After the completion of each unit, post-test was conducted by the researcher himself for both the experimental group and the control group on same dates. Those post-tests were marked by researcher according to the rubrics.

Analysis of Post-tests of control group and experimental groups

Table 3: Independent t-test for comparison of groups on Post Test-1

	Mean	N	Std. Deviation	T	Df	Sig.(2-tailed
Post -Test 1 Control Group	14.20	25	3.742	11.120	24	.000
Post-Test 1 Experimental Group	22.72	25	1.671			

In table 3, mean value of experimental group is higher than that of control group. Moreover, the observed p-value [*t* (24) = 11.120, *p*=.000] is less than .05. It shows that there is significant improvement in the experimental group than control group in post-test regarding achievement after treatment i.e., the teaching with activities is more effective than lecture method teaching.

Table 4: Independent t-test for comparison of groups on Post Test-2

	Mean	N	Std. Deviation	T	Df	Sig.(2-tailed
Post -Test 2 Control Group	14.52	25	3.441	11.343	24	.000
Post-Test 2 Experimental Group	22.96	25	1.620			

In table 4, mean value of experimental group is higher than that of control group. The observed p-value [*t* (24) = 11.343, *p*=.000] is less than .5, which is significant. So the two groups are different in achievement. It shows that there is significant improvement in the experimental group in post-test than control group regarding achievement after treatment i.e., the teaching with activities is more effective than lecture method teaching.

Table 5: Independent t-test for comparison of groups on Post Test-3

	Mean	N	Std. Deviation	T	Df	Sig. (2-tailed)
Post -Test 3 Control Group	14.16	25	3.300	11.731	24	.000
Post-Test 3 Experimental Group	22.92	25	1.631			

In table 5, mean value of experimental group is higher than that of control group. The observed p-value [t (24) = 11.731, *p*=.000] is less than .05 which is significant. So the two groups are different in achievement. It shows that there is significant improvement in the experimental group in post-test than control group regarding achievement after treatment i.e., the teaching with activities is more effective than lecture method teaching.

Table 6: Independent t-test for comparison of groups on Post Test-4

	Mean	N	Std. Deviation	T	Df	Sig. (2-tailed)
Post -Test 4 Control Group	14.48	25	3.177	12.062	24	.000
Post-Test 4 Experimental Group	23.04	25	1.541			

In table 6, mean value of experimental group is higher than that of control group. The observed p-value [*t* (24) = 12.062, *p*=.000] is less than .05 which is significant. So, the two groups are different in achievement. It shows that there is significant improvement in the experimental group in post-test than control group regarding achievement after treatment i.e., the teaching with activities is more effective than lecture method teaching.

Table 7: Independent t-test for comparison of groups on Post Test-5

	Mean	N	Std. Deviation	T	Df	Sig. (2-tailed)
Post -Test 5 Control Group	14.84	25	4.598	8.758	24	.000

	Mean	N	Std. Deviation
Post-Test 5 Experimental Group	23.04	25	1.567

In table 7, mean value of experimental group is higher than that of control group. The observed p-value [*t* (24) = 8.758, *p*=.000] is less than .05 which is significant. So the two groups are different in achievement. It shows that there is significant improvement in the experimental group in post-test than control group regarding achievement after treatment i.e., the teaching with activities is more effective than lecture method teaching.

Table 8: Independent t-test for comparison of groups on Post Test-6

	Mean	N	Std. Deviation	T	Df	Sig. (2-tailed)
Post-Test 6 Control Group	14.00	25	3.342	14.738	24	.000
Post-Test 6 Experimental Group	23.48	25	1.262			

In table 8, mean value of experimental group is higher than that of control group. The observed p-value [*t* (24) = 14.738, *p*=.000] is less than .05 which is significant. So the two groups are different in achievement. It shows that there is significant improvement in the experimental group in post-test than control group regarding the achievement after treatment i.e., the teaching with activities is more effective than lecture method teaching.

Data analysis of 6 post tests in table 11 revealed that students in experimental group performed better than students in control group. Therefore, it may be concluded that activities included in 10^{th} Grade Physics Curriculum played crucial role in development of concepts.

Findings

The following findings emerged from the study as a result of analysis of data:

1. The performance of experimental group was better than control group in post-test 1 as a result of treatment.
2. The performance of experimental group was better than control group in post-test 2 as a result of treatment.
3. The performance of experimental group was better than control group in post-test 3 as a result of treatment.
4. The performance of experimental group was better than control group in post-test 4 and this was possible as a result of treatment.
5. The performance of experimental group was better than control group in post-test 5 as a result of treatment.
6. The performance of experimental group was better than control group in post-test 6 as a result of treatment.

Discussion

According to Alarcon (2003), active learning promotes the conceptual understanding of the learners and enhances their cognitive learning. Through this, basic concepts are determined and this makes possible for advanced learning.

Suydam, Marilyn and Higgins (1977), Shepherd (1998),Thornton (2001), Schmidt and Van der Molen (2002), Schmidt et al.,(2006), Choo (2007) , Hung, Janssen and Liu (2008), remark that, the impacts of ABL are undeniable on the capabilities of the learners. It provides the concrete foundations in problem solving and prepares them for professional life. Education Researchers (Barron, Schwartz & Vye, 1989) ; Vosniadou & Brewer ,1992; Bransford, Brown & Cocking ,1999 ; Hake,1998) have found that top to toe involvement of the learner is necessary for profound and conceptual perception which may be received through the hand-made activities.

In Traditional methods, teacher plays an active role whereas the role of learners remains passive. While, Tangible and tactile learning is necessary in problem-solving. Hence, in these methods, there is very little tactile learning. It stress on cramming and mechanical learning (Kolb ,1984; Domin ,2007),. Therefore, scores of the both groups (control and experimental), were almost same before conducting the research because they were taught by traditional methods. Therefore, Activity based learning shows better results as compared to other traditional methods for learning, if these activities should incorporate in the curriculum at the initial stage. Results of this study also support these views as experimental group taught with activities performed significantly better than control group which was taught with traditional method.

Recommendations

Following are the recommendations based on findings of this study:

1. Activity based teaching has proved to be very effective teaching strategy for fostering the understanding level of students in the subject of physics. Therefore, the teachers especially science teachers of Physics should be provided pre-service and in-service training for the implementation of this teaching strategy at large scale.
2. The teaching through activities will create interest in students for studying Physics and students will learn in depth due to this teaching strategy. It is recommended that this teaching strategy should be adopted for teaching of physics.
3. It is recommended that science teachers should adopt activity-based teaching strategy in science subjects like Chemistry, Biology, to decrease the difficulty level of the subject.
4. The Heads of the institutions should set the time table in such a way that period of science subjects will be given more time than other subjects for activity-based teaching.
5. The Heads of the institutions will make necessary arrangements and provide necessary apparatus (equipment) to science teachers for activity-based teaching.
6. It is recommended that The Heads of the institutions will encourage the science teachers who adopt activity based teaching strategy.
7. Since this research was limited to the subject of physics at secondary level and only two boys' schools from rural area were selected to examine the impact of activity based teaching on student's achievement. So it is recommended that similar studies should be conducted in other subjects of science for both genders in urban and rural areas.

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