Original Article

Effect of Activity Based Teaching Method on Academic Achievement of Students for Learning General Science at Elementary School Level

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ABSTRACT

Aim of the Study: The main purpose of this study was to determine the effect of activity-based teaching on students' academic achievement towards General Science.

Methodology: Ninety female students of seventh grade were randomly selected as sample of the study. Thirty, randomly selected female students were assigned to comparison group and thirty were assigned to experimental group. Treatment was given for a period of eight weeks. The experimental group was taught through activity-based teaching method on the other hand, the comparison group was taught through lecture method. The design of experimental study was randomized pre-test posttest control group design. A table of specification was prepared to develop achievement test, compromising the content of science subject used for teaching. The achievement test was administrated as a posttest to measure the difference of students' scores after treatment. Independent sample t-test was used to compare groups.

Findings: The results showed that there was significant difference between the performance of experimental group contrary to comparison group with reference to knowledge and understanding.

Conclusion: The study revealed that activity-based teaching method was much more effective than the lecture method in teaching of general science at elementary level.

Keywords: Activity Based Learning, General Science, Academic Achievement, Elementary Level.

Introduction

The present era is the era of science and technology where scientific discoveries have shaped our lives. Science has changed our understanding about the world through inventions. The scientific issues are accelerating around the corner and science is considered a platform of delivering news about health, genetically engineered food, global warming, cloning and environmental discourse on acid rain to ozone



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depletion. Science is a part of everyday life that surrounds one 's day to day activities. Therefore, this age emphasizes that science should be adopted by every individual to cope with modern world (Akhtar & Saeed, 2021).

Research studies clearly depicted that a bulk of students feel that science is a difficult subject. It is obvious that the subject of science is recognized as the most difficult and the dullest subject in school because it contains abstract concepts and theories. There are many drawbacks in teaching science in schools. The techniques that are used for teaching science do not consider the requirements of students. Scientific knowledge is delivered through texts and conventional lectures and this knowledge tends learners to memorize information(Adu-Gyamfi, 2014)

In the past, before books were not readily available, education relied on teacher-centered instruction and memorization. Classroom time was filled with repetitive drills and recitation of textbook material. Traditional teaching methods involved using a blackboard and chalk to convey theoretical concepts through lectures and discussions. Students were expected to take notes and memorize them after the lecture. The lecture method was the most common approach of teaching. Unfortunately, in this era of information and technology our schools use conventional methods of teaching in which students sit quietly as passive listeners in the class and as a result they refuse to think critically. The traditional teaching methods that rely on passive listening are no longer suitable for teaching science subjects in schools. Active participation of students is necessary for meaningful learning and teacher proficiency is crucial for school development(Balliu, 2017).

Science is a subject that requires exploration and experimentation rather than rote memorization. It demands an inquisitive mind and scientific attitude to develop a meaningful understanding of new concepts. The teacher plays a crucial role in leading students towards problem-solving and innovation in the laboratory. Learning occurs when teachers and students work together, with the teacher as an artist providing new styles to materials encountered in the classroom. To improve learning outcomes, the quality of interaction between teachers and students needs to be enhanced. Top-performing school systems recognize that improving instruction is the key to achieving better results(Tilgner, 1990).

The constructive theory of education emphasizes the active participation of learners in the learning process. It suggests that learners construct their own knowledge by participating in activities and conveying their understanding to others. This approach values learner-centered education and challenges teachers to provide techniques that support students' construction of understanding(Singh & Yaduvanshi, 2015). Activity-based teaching is a form of constructive learning theory where learners act as active participants and teachers act as facilitators. It involves manipulation, exploration and thinking about intangible concepts, making it a suitable method for teaching science at the elementary level (Padmavathi, 2013).

Elementary school learners in the concrete operational phase get benefit greatly from reasoning skills. Their environment plays a vital role in developing their abilities and competencies in various areas of knowledge. Active engagement in learning is crucial for cognitive development as learners attempt to express their thoughts in the best possible manner. Multi-sensory activities, such as verbal games, discussions, and storytelling, are effective teaching methods compared to traditional lecture-based teaching. Elementary science classes require a student-centric approach such as activity-based learning. This approach allows students to actively participate in the learning process by manipulating and exploring scientific concepts. Traditional teaching methods are not suitable for teaching science as they do not involve direct observation or manipulation of materials. Educators such as Montessori, Gandhi, Dewey, Piaget, and Vygotsky emphasized the importance of activity-based teaching in contrast to conventional methods(Basantia, Panda, & Sahoo, 2012).

The activity-based teaching method creates a lively and enthusiastic environment for students to learn science. It allows them to engage in hands-on activities, develop new concepts, and compare them with existing ones. Optimum learning environments that promote exploration can make learning joyful and lasting. Although activity-based teaching can promote critical thinking, problem-solving and creativity, among students. Activity base teaching should recommend for better understanding in scientific knowledge, but our classrooms are run by traditional techniques(Khan, Muhammad, Ahmed, Saeed, & Khan, 2012).

Statement of the Problem

The problem regarding this study is stated as under:

The teaching methodology has a key role in the learning process. At elementary level, learners are obviously more inquisitive that makes general science a favorite subject for them to learn. General science enables students to investigate their world and explore new things. General science is also an active subject comprising activities such as experiments and hands on activities that make general science entirely appropriate to active learners. (Ramey-Gassert, Shroyer, & Staver, 1996). The problem is that the lecture method of teaching is commonly used instead of the more effective activity-based learning approach, which actively engages students with explanatory ideas. It is assumed that teachers do not make use of activity-based teaching methods, while this method is considered cornerstone for the cognitive development of learners. This situation has motivated the researcher to conduct the research to determine which approach is more useful for teaching general science. The researcher has designed this experimental study to find out the effect of activity-based teaching on student's academic achievement in general science at elementary level.

Research Objective

Determine the effect of activity base teaching method on students' academic achievement in teaching of General Science at elementary level.

Research Hypotheses

- 1. There is no significant difference in the achievement level of students of 7th grade in science whether they are taught with traditional lecture method or activity base teaching method.
- 2. There is no significant difference in knowledge level of students of 7th grade in science whether they are taught with traditional lecture method or activity base teaching method.
- 3. There is no significant difference in the understanding level of students of 7th grade in science whether they are taught with traditional lecture method or activity base teaching method.

Need and Significance of Study

Science teaching has assumed a significant place at elementary level and its importance in today's world is increasing day by day. In the present educational system, there is a change from the teacher centered approach to learner centered approach and activity-based learning is based on learner centered approach. Activity Based teaching (ABT) method is an example of such learner centered technique and it provides activity oriented and joyful learning. The traditional teaching method gave boredom to the learners. Now a day's emphasis of science teaching is not to make every student scientist but to develop scientific attitude towards science. Pakistani students' achievement in science is low. Students in Pakistan are showing negative attitude for learning science because teaching is teacher centered and based on memorization of factual knowledge. The consequences of this situation lead to the rote learning of the learners with no deep understanding of scientific concepts, phenomenon, and theories. The need for concrete experiences in science instruction is advocated because they can enhance students learning and can provide a more authentic view of science. It is need of the hour that learners should engage actively with explanatory ideas that will motivate them to understand abstract concepts and will enable them to adopt positive attitude for general science. The prerequisite of this hour is to develop a scientific attitude in every student. So, a study on activity-based teaching method for learning science in elementary schools is very essential.

- 1. The findings will be significant for teachers. It will encourage teachers to adopt activity base teaching method during general science teaching in the science classrooms.
- 2. The results of this study will be significant for students. The results of the study will motivate them to do tasks by themselves, apply their ideas practically and inspire them to think critically.
- 3. The findings of this study will be useful for educational planners and curriculum designers to apply activity base teaching method in teaching of science.

Delimitation of the Study

The study was conducted on female students only studying in public school. The study was confined only to 7^{th} class general science students.

Literature Review

Humans are naturally curious and seek to learn about their surroundings, which drives creativity and advancement. Science and technology have become essential components of our social and cultural lives, shaping every aspect of our existence from birth to death. Learning is a continuous process of gaining new information and behaviors through experiences, allowing individuals to connect and apply knowledge to various situations(Ajayi, 2017).

Science

The word "science" comes from the Latin "scientia" meaning "to recognize" and refers to a standardized collection of information. Science generates knowledge by constructing explanations and predictions based on evidence about natural phenomena (Ayala, 2008).

Importance of Science and Technology

The rapid progress of science and technology has impacted the teaching and learning of school science. The focus of science education has shifted from producing future scientists to educating the general population on current issues such as diseases, climate change, and medical advancements. There is a growing need to educate students on 21st-century science so that they can make informed decisions on these challenging issues. As a result, school science and teaching approaches need to be updated to include current sciences and develop 21st-century skills such as decision making, communication, problem-solving, and the use of innovative technology to create new knowledge(Chua & Karpudewan, 2017).

Science Teaching

Science is often viewed as a difficult subject to learn in school, and teachers strive effectively to guide their students to understand the accepted norms of the field. The classroom environment is crucial for this, as students and teachers engage in various activities such as debating, communication, and discussion. One of the biggest challenges in teaching science is the short amount of time allocated for the subject and the overload of content. Teachers often provide advanced-level of information without considering the students' capacity of understanding the knowledge, leading to difficulty in making connections between new concepts and real life (Adu-Gyamfi, 2014).

A shift towards student-centered approaches and tangible experiences in science education is recommended to improve learning outcomes. To address the difficulties in learning, two famous theories have emerged: behaviorist theory and cognitive theory. Behaviorist theory, by B.F. Skinner, emphasizes that learning is shaped by environmental factors. In contrast, cognitive theory, by Jean Piaget, highlights the internal mental activity of learners. Activity-based learning (ABL) is a constructivist approach rooted in cognitive theory that emphasizes active engagement with hands-on experiences. ABL includes applied activities, problem-solving, discussion, investigation, synthesis, and assessment to promote active

construction of new knowledge. By integrating ABL with problem-solving, students' learning experiences can be enhanced (Angsachon & Puntrakool, 2016).

Review of Previous Studies

A study conducted on activity-based teaching for construction students at Unitec New Zealand showed positive results. The teacher's response was favorable towards student involvement in final assessment, and there was an improvement in student outcomes as compared to previous classes (Harfield, Davies, Hede, Panko, & Kenley, 2007). Similar outcomes were concluded in another study that activity-based teaching approach combined with peer instruction is highly effective in teaching science education. This approach encourages hands-on activities and enables students to connect theoretical concepts with practical observations. Group discussions and reflection on scientific facts help students to understand complex scientific concepts by making this approach highly recommended for teaching science(Khan et al., 2012). While Akhtar & Saeed (2017) argue that education is a blend of theory and activity, and the educational system should be flexible to adopt suitable innovations. The traditional lecture method used in many institutions may hinder the adoption of new teaching approaches, such as activity-based teaching. Their study found that activity-based teaching is more effective than lecture-based teaching for 9th grade students in General Science, as it led to better learning outcomes across cognitive, effective, and psychomotor domains.

Similar outcomes were reported in other study showed on the sample of 611 seventh and eighth grade students registered in middle school. It was found that daily or weekly implementation of practical activities enhances students' achievement(Odom, Stoddard, & LaNasa, 2007). Activity-based learning boosts students to "learn how to learn" through different activities and real- life problems". The classes learned through the activity-based teaching method showed meaningfully good performance in the test and gained positive attitude contrary to classes who received instruction through traditional method". It is viewed that traditional teaching methods do not encourage learners to relate acquired knowledge with previous knowledge(Duch, Groh, & Allen, 2001).

There are numerous methods for learning, such as project, discovery, discussion, demonstration, laboratory and problem-solving, activity-based teaching – learning methods, etc. but, it is proved from the investigations that activity- based teaching is considered effective in teaching learning process. These approaches can work effectively if these approaches are associated with activities, without activities they will be like a lecture method.

Research Methodology

Research Design

The randomized "pretest posttest control group design "was used for this study that contains two groups experimental and control group. It is a strong experimental design in which subjects are selected randomly and assigned into two groups through random assignment then tested before experiment. The term control group is used in medical and psychology subjects. It is used for that group which has no treatment. However, in the present research study control group has also a treatment. Therefore, researchers used this term comparison group instead of control group. In this design, both groups were formed through random assignment and pretest was administered before treatment. Pretest assists the researcher to be familiar with groups, whether two groups are similar and random assignment supports in developing two equivalent groups(Fraenkel, Wallen, & Hyun, 2012; William & Stephen, 2009) .In the present study two groups were equal as the mean score for comparison group and experimental group was 69.8.

Population

The population of the study was seventh class, female students at Government Girl's High school Mandrawala, District Sialkot.

Sample and Sampling Techniques

To conduct an experiment, the researcher received approval from the school principal of a Government Girls' High School in Mandrawala, Sialkot. The study was conducted on 7th-grade students, with a population of 90 students. Sixty students were randomly selected using random sampling and were randomly divided into two groups of 30 for the experiment and comparison. Group allocation was based on pretest scores, and a sample of 30 was deemed sufficient for the study. In experimental studies the sample of thirty is enough to proceed(Fraenkel et al., 2012)

Pictorial View

Figure 1: Detail of sample selection



Instrument

Researchers used a well-made pretest from the chapter "Human organ system" to ensure that randomly assigned groups are similar on the base of abilities (appendix 1).

While achievement test was developed by researcher with the help of table of specification attached as (appendix 2). The table of specifications is a technical name of blueprint for developing a test. It is a first formal step to develop a test. It assists teacher in allotting the questions to different areas according to bloom taxonomy in a systematic manner. Researcher developed table of specification with the help of student learning outcomes which were already mentioned in National curriculum. The content list, subtopic list of students learning outcomes and cognitive domain level were arranged in two-way table

that ensured the balance and proper emphasis across all content areas covered by researcher. This table of specification also ensures the inclusion of items at each level of cognitive domain of bloom taxonomy. This table of specification indicates the number of items to be developed according to the nature of student learning objectives and level of cognitive domain. A set of 50 multiple choice items based on SLOS of selected content were developed out of which thirty-one included knowledge items and nineteen included understanding attached as (appendix 3). Each question consisted of one right answer and three "distracters". The test items were developed from the three chapters of general science. The names of the chapters were, Transport in humans and plants, Reproduction in plants and Environment and feeding relationship. Achievement test was administered to students of both groups at the end of the treatment on both groups after the completion of treatment to see students' achievement in general science.

Procedure for Data Collection

Intervention continued for 8 weeks. The researcher provided treatment to thirty students of experimental and thirty for comparison group. The activity-based teaching lesson plans were developed on the specific topic selected for intervention purposes as an exemplary lesson plan is attached as (appendix 4). One-hour schedule vacancy inside the ordinary school day was established on daily basis attached as (appendix 5). To ensure participation of students, they could choose the hour and date. Researchers used posttest at the end of the treatment to see the effect of activity-based teaching method on the academic achievement of student.

Instrument Validation

An achievement test was validated based on expert opinion and feedback from an M.Phil. group specializing in assessment and evaluation. The test was modified according to their suggestions, including revising certain multiple-choice statements, and correcting grammatical errors. The Waltz and Strickland guide indicates 0.92 as an acceptable value for the content validity index(Polit, Beck, & health, 2006; Zamanzadeh et al., 2015). After checking the expert's opinion researcher calculated the content validity ratio CVR of each item is calculated. The overall CVI was 0.92.

Pilot Study of Instrument

The pilot study for the instrument involved students from a public school rather than from the expert groups. The researcher obtained permission from the head of the school, visited the school according to schedule, and collected data from one hundred students. The collected data was analyzed using the ITEMAN software to determine the difficulty and plausibility of the test items. Mean item total, mean biserial, and reliability coefficient were calculated to assess the quality of the items. A mean inter-item score between 0.2-0.4 is considered acceptable, with scores above 0.2 indicating acceptable items. Mean biserial scores between 0.20 and 0.30 are considered fair, and those between 0.40 and 0.70 are considered good. A reliability coefficient greater than 0.7 is considered good, and in this study, the mean biserial was 0.4 and the reliability coefficient was 0.8, indicating that the items were well-constructed and internally consistent. The mean inter-item score was 0.30, which was also acceptable.

Reliability of Instrument

To ensure reliable and consistent results, researchers often use the test-retest reliability method, which involves administering a questionnaire to a sample group and then re-administering it to the same group after a period of time. In this study, 30 students who were not part of the main sample were asked to complete the test and then re-take it 15 days later. The Pearson product moment correlation coefficient was used to calculate reliability, with a value above 0.7 being considered acceptable. The test-retest reliability coefficient for this study was 0.8, indicating good reliability. Additionally, there were no differences in the answers and perceptions of the sample group in both attempts. The reliability was checked for all three factors - knowledge, understanding, and the total value - and the test-retest value was 0.8 for each.

Data Analysis

Independent sample t test was used to compare the mean scores of both experimental and comparison group. Data was analyzed using SPSS.

Results

The researcher analyzed data question wise, and the results of analysis are given below.

Objective: To determine the effect of activity base teaching method on academic achievement of students at elementary level.

Ho1: There is no significant difference in the achievement scores of students of 7^{th} grade in science whether they are taught with traditional lecture method or activity base teaching method.

The data collected against hypothesis 1 was analyzed using the t test. The detail of the table is given in table 1.

Table 1: Effect of activity-based teaching method on student's achievement scores

Test results	Ν	Mean	Std. Deviation	Т	Df	Sig(2- tailed)
Experimental	30	104.8	6.14	11.68	58	.000
Comparison	30	88.033	4.95			

Table 1 reflects the results of independent sample t test. An independent sample t test was conducted to compare the mean achievement score of experimental group who was taught through activity-based teaching method and comparison group who was taught through traditional lecture approach. There was significance difference in achievement scores of students for experimental group (M=104.8, SD=6.14; t (11.68) =58, p<.000, two tailed as compared to comparison group (M=88.033, SD=4.95). The significance difference showed that students performed well in experimental group as compared to comparison group. Thus, there is enough evidence to reject null hypothesis.

The researcher calculated the Eta squared (Effect size) using the formula t2/t2+N1-N2-1 between experimental and comparison group. The Eta value was .72 which showed the magnitude of difference was large as mentioned by Cohen (1998) as large value starts from .14.

The data collected against hypothesis 2 was analyzed using t test.

Ho2: There is no significant difference in knowledge level of students of 7th grade in science whether they are taught with traditional lecture method or activity base teaching method. The data collected against hypothesis 2 was analyzed using t test. The detail of the table is given in table 2.

Test results	Ν	Mean	Std. Deviation	Т	Df	Sig(2- tailed)
Experimental	30	64.67	4.86	6.02	58	.000
Comparison	30	57.7	3.35			

Table 2: Effect of activity base teaching method on Knowledge Level

Table 2 reflects the results of independent sample t test. An independent sample t test was conducted to compare the knowledge level of experimental group who was taught through activity-based teaching method and comparison group who was taught through traditional lecture approach. There was significance difference in knowledge scores for experimental group (M=64.67, SD=4.86; t (6.02) =58, p<.000, two tailed as compared to comparison group (M=57.7, SD=3.35). The significance difference showed that knowledge level of students was improved during with activity based teaching method as compared to lecture method teaching. Thus, there is enough evidence to reject null hypothesis.

The researcher calculated the Eta squared (Effect size) using the formula t2/t2+N1-N2-1 between experimental and comparison group. The Eta value was .38 which showed the magnitude of difference was large as mentioned by Cohen (1998) as large value starts from .14.

Ho3: There is no significant difference in understanding level of students of 7th grade in science whether they are taught with traditional method or activity base teaching method. The data collected against hypothesis 3 was analyzed using t test. The detail of the table is given in table 4.3.

Test result	Ν	Mean	St. Deviation	Т	Df	Sig(2- tailed)
Experimental	30	43.7	3.63	11.398	58	.000
Comparison	30	33.9	2.95			

Table 3: Effect of activity-based teaching method on students understanding level

Table 3 reflects the results of independent sample t test. An independent sample t test was conducted to compare the understanding level of experimental group who was taught through activity-based teaching method and comparison group who was taught through traditional lecture approach. There was significance difference in understanding level for experimental group (M=43.7, SD=3.63; t (11.39) =58 ,p<.000, two tailed as compared to comparison group (M=33.9,SD=2.95). The significance difference showed that understanding level of students was improved with activity based teaching method as compared to lecture method teaching. Thus, there is enough evidence to reject null hypothesis.

The researcher calculated the Eta squared (Effect size) using the formula t2/t2+N1-N2-1 between experimental and comparison group. The Eta value was .68 which showed the magnitude of difference was large as mentioned by Cohen (1998) as large value starts from .14.

Discussion

The result obtained from the study supports the findings of several studies that had examined the effectiveness of activity-based teaching methods. Activity based approach of learning is considered more effective for the improvement of knowledge and understanding (Coulson & Osborne, 1984; Hung, Jonassen, & Liu, 2008; Suydam & Higgins, 1977). Researchers found that students who are taught with activity based teaching method did well intellectually in science contrary to those who were involved in traditional science instruction(Amaral, Garrison, & Klentschy, 2002; Jorgenson & Vanosdall, 2002; Lee & Luykx, 2006). This study also supports the results of meta-analysis studies of activity-based science strategies in the part of achievement. Fifty-seven studies were conducted research on activity-based program, and it was found that activity-based program effect was positive on student achievement contrary to lecture method. Similar, findings were depicted in analysis of 105 studies(Shymansky, Kyle Jr, & Alport, 1983). In the present study results showed that learners scores of those students who were given instruction by activity-based teaching method were higher contrary those who were taught through lecture technique of teaching. Posttest mean score of treatment group of two levels knowledge understanding and achievement was greater than mean of non-treatment group.

Conclusions

The experiment revealed that activity-based teaching methods are highly effective in improving students' performance and thinking capacities. The approach was found to enhance students' knowledge and experiences, with a significant difference observed between activity-based and lecture-based teaching methods. The students were more engaged and enthusiastic in the learning process with the activity-based approach. Overall, the study demonstrated that the activity-based teaching method is a suitable approach for improving students' academic achievement. The results showed that this approach had a significant impact on students' aptitudes and academic performance. Therefore, it can be concluded that the activity-based approach is essential for improving students' overall academic achievement.

Recommendations

Activity base teaching may be used to enhance academic performance of students in the subject of science. It may be used to motivate learners to participate actively in the class. Activity based teaching methods may be used to improve learner's conceptual knowledge and understanding in the science subject. Teachers may use activity-based teaching methods in teaching general science and other subjects. Activity based teaching methods may be used to assist students to comprehend the basic concepts of science. Therefore, teachers and students may prefer this activity-based teaching approach for scientific concept and understanding.

Future Study

This was an experimental design of study. The study may be replicated by other researchers to establish its generalizability.

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Conflict of Interest

Authors have no conflict of interest.

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