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Experimental Study Plan: Effectiveness of Activity based Teaching in the Subject of General Science at Elementary Level

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ABSTRACT
A kind of learning where students learn the concepts and lessons by doing activities and following the rule of learning by actively involved in learning process. Specifically, the study seeks to determine the extent to which activity-oriented instructional approaches influence students' academic achievement. The study were to investigate the effect of activity-based teaching on students' academic achievement, to find out the effect of activity-based teaching on students' engagement in the subject of general science, and to determine the effect of activity-based teaching on students' interest in the subject of general science. The design of the study was pre-test and post-test experimental. All students studying in 7th class and subject of general science were population of the study. Random sampling technique was applied for assigning the students to the control group, and experimental group. Treatment was given for a period of 8 weeks. The experimental group was taught through an activity-based teaching method. The control group was taught through by traditional method. A lesson plan was prepared to develop an achievement test, comprising the content of the science subject used for teaching. The achievement test was administered as a post-test to measure the difference in students' scores after treatment. An independent sample t-test was used to compare groups. The results showed that there was a significant difference between the performance of the experimental group contrary to comparison group with reference to knowledge and understanding. Furthermore, it was found that the activity-based teaching method had a positive effect on students' engagement and interest in the subject of general science. It was concluded that there was a significant difference in the attitude and motivation of students towards general science in the experimental and comparison groups in favor of the experimental group.

Introduction

Teaching and learning are interconnected processes essential for education, which equip individuals with the knowledge and skills needed to contribute meaningfully to society (Anwer, 2019). Activity-based learning (ABL) enhances critical and creative thinking by engaging students in interactive tasks, making learning more relevant and impactful. Activity-based learning is rooted in constructivist and cognitive learning theories, emphasizing hands-on experiences to deepen understanding and retention (Patil et al., 2016). This approach involves students physically and intellectually, encouraging them to explore concepts through projects, experiments, and collaborative problem-solving (Noreen, 2020). By actively participating in learning, students develop practical skills and a deeper appreciation for knowledge, guided by teachers who facilitate rather than dictate the process (Chukwudi, 2018).

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The activity-based teaching method (ABTS) prioritizes "learning by doing," incorporating mental and physical tasks that foster creativity and expression (Umoh, 2019). Active learning methodologies, including kinesthetic and collaborative tasks, enhance student motivation and long-term knowledge retention (Kuyate, 2019). Unlike traditional methods, ABL improves academic performance, higher-order thinking, and teacher-student relationships (Chukwudi, 2018). In contexts where rote memorization dominates, such as Pakistan, ABL offers a solution by replacing passive learning with dynamic, student-centered approaches (Bekirov, 2021).

Teachers must adapt to diverse classroom needs, using ABL to make learning enjoyable and goal-oriented (Dissanayake & Alahakoon, 2020). Activity-based learning transforms education into an interactive, meaningful experience. It promotes collaboration, critical analysis, and self-directed learning, preparing students for real-life challenges (Ceviz, 2023). By integrating ABL, educators can cultivate a generation of innovative thinkers capable of applying knowledge in diverse contexts (Saeed, 2021).

The coaching methodology has a key role in the learning process. At the elementary level, learners are obviously more interfering 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 containing activities such as experiments and hands-on activities that make general science totally appropriate to active learners (Ramey-Gassert, Shroyer, & Staver, 1996). The problem is that teachers teach general science through the traditional method. Activity-based teaching is considered an effective approach in teaching in which learners are actively engaged with explanatory ideas. This approach can motivate learners to understand abstract concepts and can enable them to develop a positive attitude towards general science, but our classroom practice is still traditional. It is assumed that teachers do not make use of activity-based teaching, while this method is considered a cornerstone for the cognitive development of learners. This situation has motivated the researcher to conduct research to determine which approach is more useful for teaching general science. The researcher has designed this experimental study to find out, effect of A study on the effectiveness of activity-based teaching in the subject of general science at the elementary level.

Following were the research objectives and hypothesis of the study

To investigate the effect of activity-based teaching on students' academic achievement

To find out the effect of activity-based teaching on students' engagement in the subject of general science

To determine the effect of activity-based teaching on students' interest in the subject of general science

H0 1: There is no significant difference in academic achievement between students taught using activity-based teaching and those taught using traditional methods.

H0 2: Activity-based teaching has no significant effect on students' engagement and interest in general science.

H0 3: There is no significant difference in interest towards general science between students taught using activity-based teaching and those taught using traditional methods.

Literature Review

Activity-based teaching has emerged as a transformative instructional approach that fosters active student engagement, critical thinking, and deeper conceptual understanding, particularly in science education. By incorporating hands-on activities, experiments, and collaborative tasks, this method aligns with constructivist learning theories, enabling students to construct knowledge through direct experience (Habib, 2021). Furthermore, it cultivates essential 21st-century skills such as communication,

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teamwork, and technological literacy, preparing students for future academic and professional challenges (Joyce & Cartwright, 2020).

Learning science is essential for people to become curious, have positive attitudes, and understand how science and learning interact in daily life (Lamnina & Chase, 2019). The aim is for students to become creative, effective, decent, and devoted citizens. Thus, the instruction that pupils get needs to incorporate reading skills. With coaching that enhances classroom teaching strategies, literacy skills can be developed rapidly (Guo, 2024).

In science education, hands-on learning is closely associated with inquiry-based learning, a teaching approach known to increase student interest. Inquiry-based science education encourages students to ask questions and explore intriguing ideas through investigation. Whether the learning process is designed by the teacher or the students, hands-on science allows for exploration in multiple ways (Ivory, 2023). Learning by doing" is an educational approach emphasizing active engagement, where individuals acquire knowledge and skills through direct experience and practical application. Instead of only receiving theoretical education, students engage in practical exercises that mimic real-world situations, giving them the chance to try new things, solve problems, and think back on their choices. As students relate ideas to real-world situations, this approach promotes greater comprehension, critical thinking, and long-term memory. This method, which was made popular by educational philosophers such as John Dewey, emphasizes the importance of active engagement in fostering significant and long-lasting learning outcomes. Learning by drawing is a well-liked teaching strategy that has a high prima facie plausibility. Drawing lessons are believed to help students build a comprehensive mental model (Fiorella, 2018).

The implementation of activity-based teaching faces several challenges, including inadequate teacher training, resource constraints, and resistance to shifting from traditional lecture-based methods. Teachers often struggle with designing effective activities, managing diverse student needs, and integrating technology seamlessly into lessons (Kurniasih et al., 2021). The demands of curriculum coverage and standardized testing can limit the time available for experiential learning, making it difficult to fully adopt student-centered approaches (Bazarian, 2021).

Activity-based teaching represents a dynamic and effective pedagogical strategy that enhances student learning outcomes in science and beyond. By prioritizing active participation, reflection, and real-world application, this approach not only improves academic performance but also fosters lifelong learning skills (Reinholz & Andrews, 2024). Activity-based teaching methods play a crucial role in enhancing student engagement, critical thinking, and long-term knowledge retention. The methods including, Project Method, Discovery Method, Discussion Method, Demonstration Method, Laboratory Method, and Problem-Solving Method each contribute individually to effective learning by fostering active participation, hands-on experience, and collaborative problem-solving. The Project Method, as advocated by Dewey, encourages experiential learning and real-world application. Teachers employ this technique to personalize instruction; students are invited to look up issues that interest them and utilize projects to research the solutions. Usually, this is done in small groups or individually. Projects, often known as activity-based teaching methodologies, are useful tools for the teaching process (Rothaermel, 2013). The Discovery Method, rooted in Bruner’s theories, promotes inquiry-based learning, where students construct knowledge through exploration. Discovery learning is the process by which students actively participate in the learning process. In discovery learning, learner gains information based

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on new information and data collected by them is done in a conducive learning atmosphere (Balım, 2009; Griffin & Care, 2014). The Discussion Method enhances critical thinking and peer interaction, making learning more dynamic. In discussion classrooms, students' needs and preferences are addressed because they are more likely to ask questions on their own. It can function effectively if it is connected to activities; otherwise, it will resemble a lecture style in which the teacher is thought to be the only one imparting knowledge to the students (Webb, 2021). The Demonstration Method bridges theory and practice, particularly in resource-limited settings. Although the method quickly covers a larger area, it is not a student-centered approach to instruction. The student-centered demonstration technique describes a teaching strategy where the teacher acts as the principal or actor while the students watch with the intention of acting later. The teacher does whatever the students are asked to do at the end of the class by showing them how to fix it and outlining the step-by-step procedure. (Daluba, 2013). The Laboratory Method strengthens conceptual understanding through experimentation). The laboratory approach gives students vitality and has significant educational value. When students participate in various experiments and observe the experiment, they are being active. Thus, vitality is observed in the classroom during an experiment. Learning by doing creating, researching, and carrying out experiments is the best method of instruction. The laboratory gives students the chance to participate in science-related activities and learn about the scientific process. A learning laboratory is a location where new information is produced through observation, idea generation, and data interpretation (Darcin, 2006).

Research Methodology

Pretest posttest experimental design was used for this study. Government high school Roras, Sambrial was randomly selected as a site for experimentation from all high schools of tehsil Sambrial. All students studying in 7th class and subject of general science were population of the study. There were eighty five students studying in Government high school Roras. Out of these eighty five (85) students, sixty (60) students were randomly selected for this study. Equal number of students was distributed into two group of students' viz experimental group (EG) and Control Group on the basis of previous academic record. Primarily both groups contained students of almost same achievement level. Each group contained (30) students. Five units of general science for class 7^{th} were selected for intervention keeping in view the time and availability of the session time. For this last units were selected for providing intervention to the students. Acids, bases/alkalies and salts (unit6), force and pressure (unit 7), physical quantity measurements (unit 8), thermal energy sources and effects (unit 9), and lenses (unit 10) were selected for treatment. An MCQ-type written test was developed to collect data. The pretests were developed from the first five units for the Government high school Roras 7^{th} class science course with Bloom's taxonomy in mind. From the 50 questions, 10 knowledge questions, 10 comprehension questions, 10 application questions, 10 analysis questions, and 10 comprehension questions were prepared. Students were matched on the basis of average marks in all levels of Blooms taxonomy. The posttest was developed from five units already mentioned above. The effectiveness of the tool's content was determined by discussion with three subject matter experts and science education educators. Pre- and post-test reliability was through split half reliability technique. Test reliability was found to be at 0.81 and 0.87. Thirty (30) lessons were prepared from these five units. These thirty lessons were taught for five weeks (30days). Prior to treatment, both experimental and control groups underwent pre-testing. The

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research team prepared 30 lessons from its five units above with the help of the class teacher. A science teacher was trained for ABL model. Trained teacher was assisted on daily basis during the intervention time. At the end of intervention of ABL both controlled students and under experiment students were treated with posttest. Posttest was marked and analyzed with the help of SPSS.

Data Analysis

Pretest was employed before start of the teaching of selected units. After intervention of eight weeks posttest was used. Data collected through pretest and posttest was analyzed using t-test. Data was collected by administrating pretest, marking the answers and developing the award list. Same procedure was done for posttest.

Table 4.1

Paired Sample t-test for the Comparison of achievement pre-test and post-test of the control group

Test result	N	Mean	St. Deviation	T	Df	Sig(2-tailed)
Pretest	30	11.4	2.56882	.935	29	.358
Posttest	30	11.1	2.99828			

Table 4.1 shows the controlled group's achievement scores before (pretest: M=11.4, SD=2.57) and after (posttest: M=11.1, SD=2.998) the study period. Results show a negligible decrease (0.3 points) in average scores and a slight increase in variability. The paired samples t-test revealed no statistically significant difference (t (29) =0.935, p=0.358), indicating stable achievement levels throughout the study. The minor changes likely occurred by chance rather than any systematic effect.

Table 4.2 Paired Sample t test for Comparison of achievement pre-test and post-test of experimental group

Test result	N	Mean	St. Deviation	T	Df	Sig(2-tailed)
Pretest	30	10.2	2.34	-20.6	29	.000
Posttest	30	21.3	3.95			

Table 4.2 shows the dramatic improvement in the experimental group's achievement scores after the intervention. The mean score surged from 10.2 (SD=2.34) in the pretest to 21.3 (SD=3.95) in the posttest—an 11.1-point gain. This substantial increase was statistically significant (t (29) =-20.6, p <0.001), demonstrating the intervention's strong effectiveness. The results clearly show that the activity-based teaching method significantly enhanced student achievement.

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Table 4.3 Paired Sample t-test for Comparison of engagement level pre-test and post-test of the control group

Test result	N	Mean	St. Deviation	T	Df	Sig(2-tailed)
Pretest	30	85.7	2.56	-1.60	29	.120
Posttest	30	86.5	1.64			

The results show a marginal increase in engagement scores (pre-test: M=85.7, SD=2.57; post-test M=86.5, SD=1.64), representing a 0.8-point improvement with reduced variability. However, the difference was not statistically significant (t=1.60, p=0.120), indicating the intervention had no meaningful impact on engagement levels. The slight change likely occurred by chance rather than treatment effects.

Table 4.4 Paired Sample t-test for Comparison of engagement level pre-test and post-test of the experimental group

Test result	N	Mean	St. Deviation	T	Df	Sig(2-tailed)
Pretest	30	85.7	12.6	-22.3	29	.000
Posttest	30	133.3	8.28			

The experimental group showed dramatic engagement improvements after intervention, with scores jumping from 85.7 (SD=12.6) to 133.3 (SD=8.28) – a 47.6-point increase. Statistical analysis confirmed this substantial gain was highly significant ($t(29)=-22.3$, $p<0.001$), demonstrating the intervention's strong effectiveness in boosting engagement while reducing score variability. These results clearly indicate that the activity-based approach successfully enhanced student engagement.

Table 4.5 Paired Sample t test for Comparison of interest measure pre-test and post-test of controlled group

Test result	N	Mean	St. Deviation	T	Df	Sig(2-tailed)
Pretest	30	69.7	10.9	-0.40	29	.689
Posttest	30	69.9	10.2			

Table 4.5 shows virtually no change in interest scores after intervention (pre-test: m=69.7, SD=10.9; post-test: M =69.9, SD=10.2). The negligible 0.2-point difference was statistically insignificant (t=-0,40, p=0.689), indicating the intervention failed to enhance student interest. These results suggest the need for alternative approaches to effectively improve interest levels.

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Table 4.6 Paired Sample t-test for the Comparison of interest measure pre-test and post-test of the experimental group

Test result	N	Mean	St. Deviation	T	Df	Sig(2-tailed)
Pretest	30	69.7	10.9	-22.1	29	.000
Posttest	30	105.8	8.85			

The experimental group's interest scores showed a dramatic improvement following the intervention, increasing from 69.7 (SD=10.90) to 105.8 (SD=8.850), a 36.1-point gain. Statistical analysis confirmed this substantial increase was highly significant ($t(29) = -22.1$, $p<0.001$), demonstrating the intervention's strong effectiveness in boosting student interest while reducing score variability. These findings indicate that the activity-based approach successfully enhanced students' interest in the subject.

Discussions

Based on the results of the paired sample t-tests presented for each objective, let's examine the hypotheses and discuss the rejections, leading us to formulate alternative hypotheses.

Hypothesis H0 1

"There is no significant difference in academic achievement between students taught using activity-based teaching and those taught without activity-based methods." The results indicate that there was no significant change in achievement scores in the controlled group, suggesting that traditional methods of teaching had little to no impact. In contrast, the experimental group showed a significant change in scores, which can be attributed to the use of activity-based teaching.

Alternative Hypothesis H1

"There is a significant difference in academic achievement between students taught using activity-based teaching and those taught using traditional methods. "The null hypothesis (H0 1) is rejected for the experimental group, suggesting that activity-based teaching significantly improves academic achievement. The alternative hypothesis is supported.

Hypothesis H0 2

"Activity-based teaching has no significant effect on students' engagement in general science. In the controlled group, engagement levels showed only a small increase that was not statistically significant, suggesting that traditional teaching methods did not impact engagement. The experimental group, however, demonstrated a remarkable improvement in engagement after using activity-based teaching methods.

Alternative Hypothesis H2

"Activity-based teaching significantly increases students' engagement in general science. "The null hypothesis (H0 2) is rejected for the experimental group, showing that activity-based teaching significantly increases student engagement in general science. The alternative hypothesis is supported.

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Hypothesis H0 3

"There is no significant difference in interest towards general science between students taught using activity-based teaching and those taught using traditional methods. "For the controlled group, the small change in interest scores was not statistically significant, suggesting that traditional teaching did not significantly influence students' interest in general science. In contrast, the experimental group showed a large increase in interest, indicating that activity-based teaching methods had a substantial positive impact on students' interest.

Alternative Hypothesis H3

"Activity-based teaching significantly increases students' interest in general science. "The null hypothesis (H0 3) is rejected for the experimental group, indicating that activity-based teaching significantly increases student interest in general science. The alternative hypothesis is supported.

In conclusion, the results from the experimental group provide strong evidence in favour of the effectiveness of activity-based teaching across all three objectives; academic achievement, engagement, and interest. In contrast, the controlled group showed no significant improvements, reinforcing the impact of the intervention.

Findings

Inferential analysis revealed the following analysis

Comparison of achievement test of controlled group showed p-value of 0.358, greater than 0.05, indicating no statistical significance. The controlled group's achievement scores remained relatively stable. There is no statistically significant difference between pre-test and post-test scores

Achievement measure of group under experiment showed the intervention was extremely effective in enhancing achievement scores. The highly significant difference between pretest and posttest scores ($t(29) = -20.6$, $p < 0.001$) demonstrates the intervention's substantial impact. Average achievement scores increased by 11.1 points (from 10.2 to 21.3).

Pre-test and post-test for engagement level of controlled group presents the t-value (-1.60) which indicates a small effect size. The p-value (0.120) is greater than 0.05, indicating no statistically significant difference between pre-test and post-test scores. This suggests that the intervention did not have a statistically significant impact on engagement scores.

The analysis of pre-test and post-test for engagement level of treatment group resulted that intervention was extremely effective in enhancing engagement scores. The highly significant difference between pre-test and post-test scores ($t(29) = -22.3$, $p < 0.001$).

By the analysis of pre-test and post-test in interest measure reveals that the mean pre-test score of 69.7 was virtually identical to the mean post-test score of 69.9, with a negligible increase of only 0.2 points. Which means there is no significant difference in overall results

Results revealed that the intervention was extremely effective in enhancing interest scores. The highly significant difference between pre-test and post-test scores ($t(29) = -22.1$, $p < 0.001$) demonstrates the intervention's substantial impact.

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Conclusion

The study on the effectiveness of activity-based teaching in the subject of General Science at the elementary level revealed significant improvements in students' academic achievement, engagement, and interest. The experimental group, which was exposed to activity-based teaching strategies such as small group interactions and collaborative learning, showed better performance in the post-test compared to the control group. The findings suggest that activity-based learning fosters deeper understanding and retention of scientific concepts by encouraging active participation rather than passive learning.

Moreover, the study highlighted the positive impact of activity-based teaching on student engagement. The experimental group displayed a higher level of involvement, enthusiasm, and curiosity towards science lessons. The interactive nature of the activities facilitated meaningful learning experiences, enabling students to grasp complex scientific concepts more effectively. In contrast, students in the control group, who followed traditional teaching methods, demonstrated comparatively lower levels of engagement and motivation.

It was concluded that the research supports the adoption of activity-based teaching methods in elementary science education. The findings emphasize the importance of incorporating hands-on learning experiences to enhance student interest and academic performance. Given the significant differences observed between the experimental and control groups, it is recommended that educators integrate activity-based strategies into their teaching practices to create a more interactive and effective learning environment for young learners.

Recommendations

After conducting the study, following recommendations were made for the future:

The study demonstrates the effectiveness of activity-based teaching in enhancing achievement scores, engagement, and interest in General Science at the elementary level. Teachers are recommended to incorporate activity-based teaching methods into their practice.

The significant improvement in achievement scores and engagement suggests that hands-on activities are essential in activity-based teaching. Teachers should prioritize activities that promote experiential learning.

The study's findings suggest that activity-based learning can be an integral part of the General Science curriculum at the elementary level.

Schools and administrators can provide ongoing support to teachers, including resources, mentoring, and coaching, to help them implement activity-based teaching effectively.

Future studies can investigate the long-term effects of activity-based teaching on student achievement, engagement, and interest in General Science.

Comparative studies can be conducted to compare the effectiveness of activity-based teaching with traditional teaching methods in General Science.

Future studies can explore the effectiveness of activity-based teaching in other subjects, such as mathematics, language arts, and social studies.

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