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Effect of Activity Based Method on Students Academic Achievements in Mathematics at Elementary Level

Arsalan Qayyum
Arslan.qayyum.786@gmail.com
MPhil Scholar, Department of Education and Research Muslim Youth University Islamabad

Dr. Safdar Hussain
Safdar.hussain@myu.edu.pk
Assistant Professor, Department of Education and Research Muslim Youth University Islamabad.

Babar Ishtiaq
babarishtiaqmyu@gmail.com
M.Phil Scholar, Department of Education and Research Muslim Youth University Islamabad

Corresponding Author: Arsalan Qayyum Arslan.qayyum.786@gmail.com

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ABSTRACT

This study examined the effect of the Activity Based Teaching Method on the academic achievement of elementary school students in Mathematics. Activity based instruction emphasizes students' active involvement through hands on tasks, problem solving activities, and collaborative learning experiences designed to make mathematical concepts more meaningful and accessible. A quasi experimental research design was employed, involving an experimental group taught through activity based methods and a control group taught using traditional lecture based instruction. The sample consisted of 60 Grade 7th students. A mathematics achievement test was administered as both a pretest and a posttest to measure changes in students' performance over the intervention period. The study was grounded in constructivist learning theory, which emphasizes that learners actively construct mathematical understanding through experience and interaction. The findings revealed that students taught using the Activity Based Teaching Method achieved significantly higher posttest scores than those taught through traditional methods. The results indicate that activity based, student centered instruction enhances conceptual understanding and improves academic achievement in mathematics. The study recommends the integration of activity based strategies into mathematics classrooms to promote deeper learning and improved student outcomes.

Keywords: *Activity Based Learning, Mathematics, Academic Achievement, Elementary Education, Experimental Study, Student Engagement. Constructivist Learning, Pakistan*

INTRODUCTION

Effective education is fundamental to students' academic success, and teaching strategies at the elementary level play a critical role in shaping learning outcomes. In mathematics education, traditional methods such as rote memorization and lecture based instruction are commonly used; however, these approaches often emphasize procedural knowledge at the expense of conceptual understanding, reasoning, and problem solving skills. As a result, many students struggle to connect mathematical concepts with real life applications.

Activity based learning (ABL) offers a student centered approach that actively engages learners through hands on activities, collaborative tasks, and problem solving situations. In mathematics classrooms, activity based instruction includes the use of manipulatives, mathematical games, group work, and real world

applications that make abstract concepts more concrete and meaningful. Gupta (2023) noted that activity based strategies are more effective than traditional methods in developing higher order thinking skills and sustaining student engagement.

Research evidence suggests that students taught mathematics through activity based methods achieve better academic outcomes than those taught through conventional instruction. Khan and Inamullah (2020) highlighted that ABL accommodates diverse learning styles, including visual, auditory, and kinesthetic learners, while promoting essential 21st century skills such as communication, collaboration, and critical thinking. Furthermore, learner centered approaches reduce classroom boredom and foster positive student–teacher interactions, creating a supportive learning environment (Tadesse & Gillies, 2015).

Although the effectiveness of activity based learning in mathematics has been widely reported in international studies, there is a lack of empirical research focusing on government elementary schools in Rawalpindi. Therefore, this study examines the effect of activity based teaching methods on the academic achievement of Grade 7 mathematics students at Government Boys' Elementary School Dadhar Najjar, Rawalpindi. The study aims to contribute empirical evidence to inform instructional practices and improve mathematics learning outcomes in government school contexts.

Meaning of Activity in Mathematics

- An activity in mathematics refers to a purposeful learning task that actively engages students' cognitive, physical, or social abilities.
- It involves students in performing specific mathematical actions such as exploring patterns, manipulating objects, solving problems, and applying concepts to real life situations.
- Mathematical activities require direct learner participation rather than passive listening.
- Such tasks promote learning through practice, reasoning, and interaction.
- Activities help students construct mathematical understanding through engagement with materials, peers, and meaningful mathematical contexts.

Meaning of Activity Based Teaching in Mathematics

- Activity Based Teaching (ABT) in mathematics is a learner centered instructional approach where learning occurs through structured activities rather than lectures alone.
- It emphasizes the use of hands on tasks, mathematical experiments, group discussions, and problem solving exercises.
- Learning takes place through and from active student participation in mathematical tasks.
- Activities serve as the primary medium for concept acquisition, application, and reinforcement.
- This approach supports the development of logical reasoning, critical thinking, and conceptual understanding.

According to Pakistan Social Sciences Review (2022), activity based learning involves the deliberate integration of instructional activities by teachers to enhance student engagement and promote meaningful learning outcomes.

Historical Background of Activity Based Teaching

Activity Based Teaching developed during the mid-twentieth century as educators began to question the effectiveness of rote learning and lecture based instruction, particularly around the period of World War II. David Horsburgh is recognized as an early pioneer of this approach and introduced it through the Neel Bagh School in Kolar, India, where academic subjects were integrated with practical, hands on activities. His work emphasized learner centered and experiential education, highlighting that students learn more effectively when they are actively engaged in meaningful tasks rather than passively receiving information.

Statement of Problem

Mathematics education at the elementary level aims to develop students' logical reasoning, critical thinking, and problem-solving skills. Research indicates that mathematics learning becomes more meaningful and effective when students actively engage with concepts through hands-on activities, manipulatives, visual representations, and real-life problem-solving situations (Khan & Inamullah, 2020). Activity-based teaching aligns well with students' cognitive development and supports deeper conceptual understanding.

However, in many elementary classrooms, mathematics is still predominantly taught using traditional lecture-based methods that emphasize memorization and procedural practice. Such approaches often fail to actively involve students in the learning process and may result in anxiety, lack of interest, and superficial understanding of mathematical concepts.

Objectives of the Study

The objectives of study were:

1. To examine the effect of Traditional method on academic achievement in the subject of Mathematics.

2. To examine the effect of Activity based method on students' academic achievement in the subject of Mathematics.

3. To compare the Traditional and Activity based method in subject of Mathematics.

Research Questions of the Study

The research questions of the study were:

- What is the effect of the traditional teaching method on the academic achievement of 7th grade students in Mathematics?

- What is the effect of the activity based method on the academic achievement of 7th grade students in Mathematics?

- How does the academic performance of students taught with activity based method compare to those taught with traditional methods in Mathematics?·

Hypotheses of the Study

The hypotheses of the study were:

- Ho3. There is no significant effect of traditional method on students academic achievement in mathematics.
- Ho4. There is no significant effect of activity based method on students academic achievement in mathematics.
- Ho6. There is no significant difference in Mathematics achievement between traditional and activity based methods.

Significance of the Study

Mathematics education is essential for developing logical reasoning, problem-solving abilities, and critical thinking skills among students. However, traditional teaching approaches that emphasize memorization and routine procedures often reduce students' interest and conceptual understanding. Activity-Based Learning addresses these challenges by engaging learners through hands-on activities, real-life problem solving, and interactive tasks that make abstract mathematical concepts more meaningful.

This study is significant because it examines the effectiveness of Activity-Based Learning in enhancing the academic achievement of Grade 7 students in Mathematics within the context of Pakistani public schools. By applying Bloom's Taxonomy, the study demonstrates how mathematics instruction can be structured to promote higher-order thinking skills such as analysis, application, and evaluation. The results of this study are expected to assist teachers, administrators, and curriculum planners in improving instructional practices, reducing learning difficulties, and creating more engaging and effective mathematics classrooms.

LITERATURE REVIEW

Activity Based Learning and Academic Achievement in Mathematics

Mathematics education has traditionally relied on lecture based instruction and rote memorization, often emphasizing procedural knowledge over conceptual understanding. While such approaches may support short term recall, they frequently fail to develop students' reasoning, problem solving, and application skills. Activity based learning (ABL) has emerged as an effective alternative, promoting active engagement, exploration, and meaningful learning in mathematics classrooms.

Research evidence indicates that activity based instructional strategies significantly improve students' mathematics achievement. Gupta (2023) demonstrated that students taught through activity based methods exhibited higher problem solving abilities and academic performance than those taught using traditional approaches. Noreen et al. (2020) similarly found significant achievement gains among Grade 7 students taught mathematics through activity based instruction, particularly in geometry.

Studies conducted in African and South Asian contexts further validate the effectiveness of ABL in mathematics education. Mokiwa and Agbenyeku (2019) reported improved academic performance among

gifted junior secondary students taught using activity based strategies. Durojaiye Jekayinfa and Oloda (2021) found significant differences in mean achievement scores favoring students taught through activity based instruction. Sanjo and Konye (2024) also observed superior mathematics performance among primary students exposed to activity based learning compared to traditional methods.

Some studies have examined students' attitudes alongside achievement. Çelik (2018) reported improved academic performance through activity based learning, although attitudes toward activities declined, suggesting the importance of activity design and classroom management. Oribhabor (2020) emphasized that activity based instruction enhanced mathematical proficiency when combined with adequate teacher training and scaffolding.

Theoretical Perspectives Supporting Activity Based Mathematics Instruction

Constructivist learning theory provides a strong foundation for activity based mathematics teaching by emphasizing knowledge construction through active engagement and reflection. Mathematical concepts become more meaningful when students manipulate objects, solve real life problems, and collaborate with peers. Research supports that constructivist oriented mathematics instruction enhances conceptual understanding and transfer of learning.

Experiential learning theory further strengthens the rationale for activity based mathematics instruction. Kolb's learning cycle supports the use of manipulatives, real world problem solving tasks, and reflective discussion, enabling students to connect abstract mathematical concepts with concrete experiences. Such approaches have been shown to improve retention and problem solving abilities.

Behaviorist principles also contribute to mathematics learning through repetition, reinforcement, and immediate feedback, particularly in skill based areas such as computation and basic operations. However, reliance solely on behaviorist methods may limit conceptual growth, emphasizing the need for a blended instructional approach.

Gardner's theory of multiple intelligences additionally supports activity based mathematics instruction by addressing diverse learner needs. Activities involving logical reasoning, spatial representation, bodily movement, and collaboration allow students to engage with mathematics according to their strengths, increasing motivation and participation.

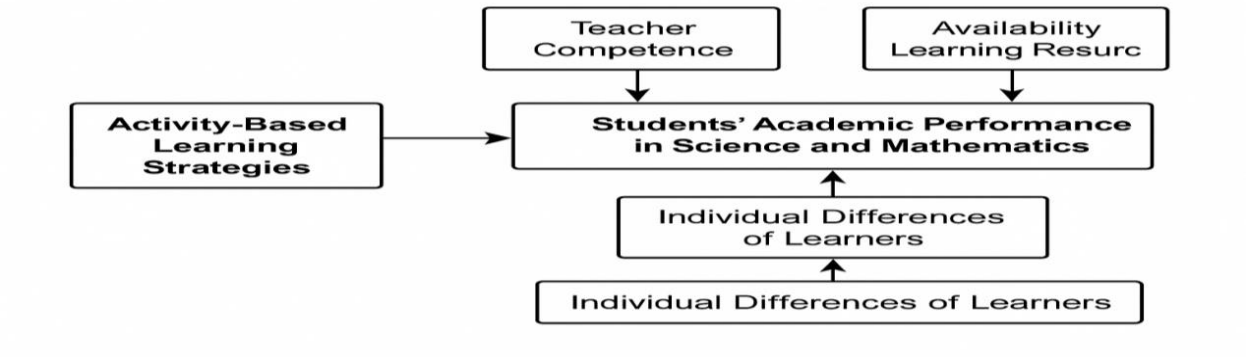

Fig 2.1: Conceptual framework of Activity based Learning

Research Gaps

Although international research supports the effectiveness of activity based mathematics instruction, limited empirical studies focus on government elementary schools in Rawalpindi. Furthermore, few studies examine the combined influence of instructional strategies, learner characteristics, and institutional factors on mathematics achievement at the middle school level. The present study addresses this gap by examining the effect of activity based learning on Grade 7 students' mathematics achievement within a government school context.

METHODOLOGY

Research Design

The study employed a quantitative experimental research design using a pretest–posttest equivalent groups approach to examine the effect of the Activity Based Method on students' academic achievement in Mathematics.

Population and Sampling

The population consisted of Grade 7 students enrolled in government elementary schools of District Rawalpindi. Government Boys Elementary School Dadhar Najjar was randomly selected, and a sample of 60 Grade 7 students was chosen.

A matched pair sampling technique was used to ensure equivalence between groups. Based on pretest mathematics scores, students were paired and randomly assigned to an experimental group (n = 30) and a control group (n = 30).

Research Instrument

A researcher developed, MCQs based mathematics achievement test, validated by subject experts, was administered as both pretest and posttest.

Procedure

The study was conducted over eight weeks. The experimental group was taught selected mathematics domains Algebra, Measurement, and Geometry using the Activity Based Method, while the control group received traditional instruction. Posttest scores were analyzed using an independent samples t test to determine the effectiveness of the intervention.

DATA ANALYSIS

This section analyzes the data collected to determine the impact of the Activity-Based Teaching Method on students' academic achievement in Mathematics. The pretest and posttest scores of the experimental and control groups were compared using an independent samples t-test. This statistical analysis was conducted to identify significant differences in mathematical achievement attributable to the activity-based instructional approach at the elementary level.

Table 1:Demographic profile of Teacher

Variable	Details
Gender	Male
Subject Taught	Mathematics
Academic Qualification	M.Sc Physics
Professional Qualification	M.Ed
Teaching Experience	Eight Years
Institution Type	Public
Location	Rawalpindi

Table 1 shows the background details of the teacher participating in the study. A male teacher from the elementary school teaches Science and Mathematics which are the relevant subjects for the research. He has earned an M.Sc in Physics, demonstrating knowledge in his field and an M.Ed which means he is trained in teaching methods. The experience of the teacher with teaching for 8 years probable means they are well skilled in instruction and classroom control. He teaches at a public school in a rural area which may change the teaching learning process because of things like fewer resources or student diversity. This profile is important for understanding why and how activity based learning is used in the research.

Table 2: Demographic profile of Students

Variable	Category	Frequency	Percentage
Gender	Male	60	100%
Location	Rural	60	100%
Age Group	11–13 Years	35	58.3%
	14–16 Years	25	41.7%
Grade Level	Grade 7	60	100%
School Type	Public	60	100%
Socioeconomic Status	Low Income	42	70%
	Middle Income	18	30%
	High Income	0	0%

Table 2 Shows a summary of the demographics of the participating students. Every student, (all 60) is male and they all come from rural regions, so the sample is diverse only in terms of age. The age group with the highest number of students (58.3%) is 11 to 13 years and the second group, making up 41.7%, is from 14 to 16 years old. Every student in the study is enrolled in Grade 7 so that the focus can be followed. The students are assigned an ordinary public school which shows another aspect of uniformity. From a socioeconomic perspective, about 70% of the students come from low income families and the rest (30%) are from middle income households; none are from high income families. It gives valuable information about the group being taught and supports understanding of what affects their reactions to and results from learning activities.

Table 3: Independent sample T test Comparing pretest Academic Achievement in Mathematics (N=60)

Group	N	Mean (M)	Standard Deviation (SD)	t value	p value
Experimental	30	48.93	15.05	0.40	0.68
Control	30	47.43	13.55	—	—

P > 0.05

Table3 shows the result of the independent samples T test comparing the pretest academic achievement scores in Mathematics between the both groups show no significant difference. The control group had a mean score of 47.93 (SD = 13.55) and the experimental group had a mean score of 48.93 (SD = 15.05). The t value was 0.40, and the p value was 0.68, which is much higher than significance level of 0.05. Based on the mean scores and t value, it was discovered that there is no significant difference between control and experimental group on pretest so the null hypothesis is accepted.

Table 4: Independent sample T test Comparing posttest Academic Achievement in Mathematics (N=60)

Group	N	Mean (M)	Standard Deviation (SD)	t value	p value
Experimental	30	61.67	9.99	3.49	0.001
Control	30	51.17	13.11	—	—

P <0.05

Table 4 displays the results of an independent samples T test comparing the posttest academic achievement scores between the experimental and control groups, revealing a significant difference. The experimental group had a mean score of 61.67 (SD = 9.19), while the control group had a mean score of 51.17 (SD = 13.11). This significant difference is further supported by a t value of 3.88 and a p value of .001. So, the null hypothesis, which states, "There is no significant difference between the students' academic achievement of experimental and control groups on posttest in Mathematics can be rejected.

Table 5: Paired sample T test on Students' Academic Achievement of Experimental Group in Mathematics (N=60)

Experimental Group	N	Mean (M)	Standard Deviation (SD)	t value	p value
Pretest	30	48.93	15.05	7.42	0.000
Posttest	30	61.66	9.99	—	—

P < 0.05

Table 5 highlighted the outcomes of the paired samples T test comparing the pretest and posttest mean scores of the experimental group in Mathematics subject. The calculated t value is 7.42 and p value is 0.000 , with the experimental group scoring a mean of 48.93 on the pretest and 61.66 on the posttest. The T test results indicate that the students' performance levels in the experimental group significantly improved from the pretest to the posttest. The substantial difference in posttest scores compared to pretest scores highlights this improvement. Additionally, the p value which was 0.000 confirms a significant difference in the achievement levels of the experimental group between the pretest and posttest. This demonstrates the positive effect of the experimental intervention.

Table 6: Paired sample T test on Students' Academic Achievement of Control Group in Mathematics (N=60)

Control Group	N	Mean (M)	Standard Deviation (SD)	t value	p value
Pretest	30	47.63	13.55	1.78	0.086
Posttest	30	51.17	13.11	—	—

P > 0.05

Table 6 showed a detailed comparison of the control group's academic performance in Mathematics subject before and after the implementation of the traditional teaching method. Specifically, the activity based learning highlights the mean scores on a pretest and a posttest, which serve as indicators of academic achievement over the period of study. The activity based learning results show the control group's pretest and posttest mean scores was 47.43 (SD = 13.55) on the pretest to 51.17 (SD = 13.11) on the posttest. The t value of 1.78 and the p value of 0.086 indicate that the improvement in scores is not statistically significant. Therefore, the traditional teaching method did not result in a noteworthy change in the academic achievement of the control group

FINDINGS

1. The pretest of Mathematics Subject in which values of the both groups were not significantly different, with mean scores of 47.43 of Control group and 48.93 of experimental group , respectively, and a p value of 0.68 . This shows that both groups started at a similar academic level, allowing for a fair comparison in the study.

2. The control group's scores increased from the pretest (mean = 47.43) to the posttest (mean = 51.17), this improvement was not statistically significant (p value = 0.086). Thus, traditional teaching methods did not significantly enhance students' academic achievement.

3. There is a significant improvement in the experimental group's scores in Mathematics from the pretest (mean = 48.93) to the posttest (mean = 61.67), with a p value of 0.000. This suggests that the Activity based intervention significantly boosted students' academic achievement..

4. There is a significant difference in posttest of Mathematics Subject in which values among the experimental group (mean = 61.67) and the control group (mean = 51.17). The p value of 0.000 confirms this difference is statistically significant, showing the positive effect of Activity based method on students' academic achievement

CONCLUSION

The findings of the study indicate that both the experimental and control groups started at a comparable level of mathematical achievement, ensuring that post intervention differences could be attributed to the teaching method rather than prior ability. After the intervention, students taught through the Activity Based Teaching Method demonstrated significant improvement in mathematics achievement, whereas the control group showed limited progress.

The results confirm that activity based mathematics instruction has a positive and statistically significant effect on students' learning outcomes compared to traditional teaching methods. The use of hands on activities, problem solving tasks, and real life applications enhanced students' engagement and promoted deeper conceptual understanding of mathematical concepts. Students in the experimental group were able to actively construct mathematical knowledge, which led to better retention and improved performance.

The study provides strong empirical support for the integration of activity based strategies in mathematics classrooms. It concludes that Activity Based Teaching is an effective approach for improving students' mathematical achievement and should be adopted by teachers and curriculum planners to promote meaningful and student centered mathematics learning.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are proposed for mathematics teachers, school administrators, and policymakers:

Provide Professional Development for Mathematics Teachers

Continuous professional development programs should be organized to equip mathematics teachers with the skills and strategies required for effective activity based instruction. Training should focus on designing mathematical activities, facilitating problem solving discussions, and managing collaborative learning in mathematics classrooms.

Equip Mathematics Classrooms with Appropriate Resources

Schools should ensure the availability of mathematics manipulatives, visual aids, models, charts, and digital tools to support hands on learning and conceptual understanding. Adequate budget allocation is necessary to create resource rich mathematics learning environments.

Promote Constructivist Approaches in Mathematics Instruction

Teachers should be encouraged to adopt constructivist teaching practices that view students as active participants in learning. Inquiry based tasks, real life problem solving, and peer collaboration should be emphasized to enhance mathematical reasoning.

Implement Differentiated Instruction Based on Learning Styles

Mathematics teachers should design activities that cater to diverse learning styles, including visual, logical, and kinesthetic learners, to ensure inclusive and effective instruction.

Encourage Further Research in Mathematics Education

Future studies should explore the long term effects of activity based learning on mathematical retention and application, as well as its effectiveness across different mathematical topics and grade levels.

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