PEDAGOGY OF LEARNING
Refereed / Peer Reviewed Journal of Education
Volume 9, Issue 2, April 2023, E-ISSN: 2395-7344
Abstracted and indexed in: Google Scholar, Research Bib, International Scientific Indexing (ISI), Scientific Indexing Services (SIS), WorldCat, Cite Factor, Website: http://pedagogyoflearning.com

Recommended citation for this Article:

Saha, A.K. (2023). Effect of activity-based approaches in enhancing learning outcomes of grade-3 students in selected topics of mathematics. *Pedagogy of Learning, 9* (2), 12-30. Available at: http://pedagogyoflearning.com.

Effect of Activity-Based Approaches in Enhancing Learning Outcomes of Grade-3 Students in Selected Topics of Mathematics

Arup Kumar Saha
Assistant Professor, Regional Institute of Education (RIE), NCERT, Bhubaneswar, Odisha, India. e-mail: saha.ganit@gmail.com

Article DOI: 10.46704/pol.2023.v09i02.002
Corresponding Author: Arup Kumar Saha, e-mail: saha.ganit@gmail.com
Article Publication Date: 30 April 2023

Abstract: Mathematics is fundamental to the development of logical reasoning, analytical thinking, and problem-solving skills among children. However, many primary school students perceive mathematics as a difficult subject due to the predominance of teacher-centred instructional practices that provide limited opportunities for active participation and experiential learning. Activity-Based Learning (ABL) has emerged as an effective learner-centred approach that promotes conceptual understanding through meaningful hands-on experiences. The present action research investigated the effectiveness of Activity-Based Learning in improving the mathematics achievement of Grade 3 students in a selected elementary school during the academic session 2019–2020. Selected topics, including number operations, fractions, measurement, geometry, and patterns, were taught using carefully planned classroom activities involving games, manipulatives, collaborative learning tasks, problem-solving exercises, and locally available teaching-learning materials. Students' achievement was assessed through teacher-developed pre- and post-tests, while classroom observations, participation records, and teacher reflective notes provided qualitative evidence of learning. The findings revealed a significant improvement in students' academic achievement, conceptual understanding, classroom participation, confidence, mathematical communication, and positive attitudes towards mathematics. Students showed greater enthusiasm and active engagement throughout the intervention. The study concludes that Activity-Based Learning is an effective pedagogical strategy for enhancing mathematics learning outcomes at the primary level and recommends its integration into classroom practices, teacher education programmes, and curriculum implementation to promote joyful, meaningful, competency-based, and learner-centred mathematics education.

Keywords: Activity-Based Learning, Primary Mathematics, Learning Outcomes, Mathematics Education, Constructivism, Classroom Activities

Introduction

Mathematics occupies a unique position within the school curriculum because it develops logical reasoning, quantitative thinking, creativity, precision, and systematic problem-solving abilities. Competence in mathematics enables learners to interpret real-life situations, make informed decisions,

and participate effectively in a knowledge-based society. Consequently, strengthening mathematics education at the elementary stage has remained a major concern of educational planners, curriculum developers, teachers, and researchers across the world.

The primary stage serves as the foundation upon which children's future mathematical understanding is built. During these formative years, learners acquire basic concepts related to numbers, operations, shapes, measurement, patterns, and data handling. These concepts form the basis for more advanced mathematical learning in later classes. If children fail to develop conceptual understanding during the early years, they often experience difficulties in higher classes, resulting in mathematics anxiety, poor achievement, and negative attitudes towards the subject.

Despite continuous curriculum reforms, classroom observations indicate that mathematics teaching in many primary schools continues to be dominated by traditional instructional practices. Lessons frequently emphasize memorisation of facts, mechanical computation, repetitive exercises, and textbook-centred instruction. Such approaches encourage students to reproduce procedures rather than understand underlying mathematical concepts. As a result, learners often become passive recipients of information instead of active constructors of knowledge.

Young learners naturally learn through observation, exploration, manipulation of objects, experimentation, play, discussion, and interaction with peers and teachers. Research in educational psychology suggests that children construct mathematical ideas more effectively when they engage directly with concrete materials and meaningful learning experiences. Therefore, classroom instruction should create opportunities for learners to investigate, explore, question, and discover mathematical relationships independently.

Activity-Based Learning (ABL) has emerged as an important pedagogical approach for promoting active participation and conceptual understanding among children. It shifts the focus of classroom teaching from teacher-centred instruction to learner-centred experiences. Instead of merely listening to explanations, students actively participate in carefully planned classroom activities that require observation, classification, comparison, estimation, measurement, reasoning, communication, and collaborative problem-solving. Such experiences make mathematical learning meaningful, enjoyable, and relevant to children's everyday lives.

The theoretical foundations of Activity-Based Learning are deeply rooted in constructivist perspectives of learning. Constructivism views learning as an active process in which learners construct knowledge through interaction with their environment rather than receiving information passively. Learners interpret new experiences in relation to their prior knowledge and continuously reorganise their cognitive structures through exploration and reflection. Classroom activities therefore become powerful tools for facilitating conceptual understanding because they enable learners to connect abstract mathematical ideas with concrete experiences.

Developmental theories also support the use of activity-oriented instruction during the primary years. Children at this stage learn more effectively when mathematical concepts are presented through concrete objects, visual representations, games, puzzles, and real-life situations before introducing abstract symbols and procedures. Collaborative learning further enhances understanding by encouraging learners to exchange ideas, explain reasoning, and negotiate meaning with peers. Consequently, activity-based classrooms create rich learning environments where students develop not only mathematical knowledge but also communication skills, confidence, creativity, and critical thinking.

The importance of learner-centred pedagogy has been emphasised in educational reforms in India. The National Curriculum Framework (2005) advocated joyful learning, reduced curriculum burden, and active participation of learners in classroom processes. It encouraged teachers to organise classroom experiences that promote inquiry, exploration, problem-solving, and collaborative learning rather than rote memorisation. Similarly, the National Education Policy (2020) reiterated the need for experiential

learning, competency-based education, and development of conceptual understanding across school subjects. These policy initiatives recognise that meaningful learning occurs when students actively engage with ideas through appropriate classroom experiences.

Primary mathematics classrooms provide numerous opportunities for integrating activity-based pedagogy. Concepts such as place value, fractions, measurement, geometry, time, money, patterns, and data handling can be effectively taught using concrete materials available in the classroom or community. Beads, sticks, bottle caps, paper strips, measuring tapes, calendars, coins, geometric shapes, flash cards, puzzles, number games, and locally available objects enable children to visualise mathematical concepts and understand relationships more effectively. Such activities also accommodate diverse learning styles and support inclusive classroom practices by allowing all learners to participate according to their abilities.

The teacher plays a central role in planning and facilitating activity-based learning. Effective implementation requires careful selection of activities aligned with learning objectives, availability of appropriate teaching-learning materials, classroom management strategies, opportunities for collaborative learning, and continuous assessment of students' progress. Teachers also need to encourage questioning, discussion, reflection, and multiple solution strategies rather than focusing solely on obtaining correct answers. The quality of teacher facilitation largely determines the success of activity-based classroom practices.

Although Activity-Based Learning has been widely recommended in curriculum documents and teacher education programmes, its implementation in many elementary schools remains limited due to inadequate teacher preparation, shortage of instructional materials, large Grade size, time constraints, and examination-oriented teaching practices. Consequently, there is a continuing need for empirical studies examining the effectiveness of activity-based pedagogy in improving students' learning outcomes in mathematics.

The present study was undertaken in this context during the academic session 2019–2020. It sought to investigate whether systematic use of Activity-Based Approaches in teaching selected topics of mathematics could enhance the learning outcomes of Grade 3 students. The intervention focused on creating learner-centred classroom experiences through games, manipulatives, group activities, worksheets, mathematical puzzles, and problem-solving tasks. The study also examined students' classroom participation, conceptual understanding, confidence, and attitudes towards mathematics. The findings are expected to contribute to the growing body of research on effective pedagogical practices in primary mathematics education and provide useful insights for teachers, teacher educators, curriculum developers, and educational administrators.

Review of Related Literature

The effectiveness of Activity-Based Learning (ABL) has been widely acknowledged in educational research as an important pedagogical approach for improving students' conceptual understanding, classroom participation, and academic achievement. The theoretical and empirical literature consistently suggests that children learn mathematics more effectively when they are actively engaged in meaningful learning experiences rather than passively receiving information. The following review presents important studies and theoretical perspectives that provide the foundation for the present investigation.

Theoretical Foundations of Activity-Based Learning

Activity-Based Learning is primarily rooted in the principles of constructivism, which views learning as an active process of knowledge construction. According to Piaget (1970), children develop cognitive structures through interaction with their environment. At the primary stage, learners are generally in the concrete operational stage, during which they understand mathematical ideas more effectively through manipulation of concrete materials before progressing to abstract reasoning. This perspective highlights

the importance of providing opportunities for exploration, experimentation, and discovery in mathematics classrooms. Vygotsky (1978) emphasised the social nature of learning and argued that knowledge develops through interaction with peers and teachers. His concept of the Zone of Proximal Development (ZPD) suggests that children learn more effectively when guided by teachers or more capable peers. Collaborative classroom activities, group work, and guided discussions therefore become important components of Activity-Based Learning.

Bruner (1966) proposed that learning occurs through three modes of representation—enactive, iconic, and symbolic. Young learners first understand concepts through actions and manipulation of objects, followed by visual representations and finally abstract symbols. Mathematics teaching based on activities naturally follows this progression and enables learners to develop conceptual understanding before formal mathematical notation is introduced. Dewey (1938) advocated learning through experience and emphasised that education should be closely connected with children's real-life situations. He believed that learners construct meaningful knowledge when they actively investigate problems arising from their surroundings. Activity-Based Learning reflects this philosophy by connecting mathematical concepts with practical experiences encountered in daily life. Kolb's (1984) Experiential Learning Theory further supports activity-oriented instruction by explaining learning as a cyclical process involving concrete experience, reflective observation, abstract conceptualisation, and active experimentation. Mathematics activities provide learners with opportunities to move through these stages, thereby strengthening understanding and retention.

Together, these theoretical perspectives establish that effective mathematics learning occurs when learners actively engage with concepts through exploration, collaboration, reflection, and application.

Empirical Studies on Activity-Based Learning

Numerous international studies have reported positive effects of Activity-Based Learning on students' mathematical achievement. Hiebert and Carpenter (1992) argued that conceptual understanding develops when learners actively construct relationships among mathematical ideas instead of memorising isolated procedures. Their work demonstrated that meaningful classroom experiences lead to deeper understanding and improved problem-solving abilities. Kilpatrick, Swafford and Findell (2001), in their influential report *Adding It Up*, identified conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition as the five strands of mathematical proficiency. They emphasised that classroom activities integrating these dimensions produce meaningful and lasting learning. Research conducted by the National Council of Teachers of Mathematics (NCTM, 2000) highlighted the importance of engaging learners in mathematical investigations, reasoning, communication, and problem-solving. The organisation recommended replacing teacher-dominated instruction with classroom environments where learners actively participate in constructing mathematical knowledge. Boaler (2002) found that students taught through activity-oriented and problem-solving approaches demonstrated better conceptual understanding, greater confidence, and improved long-term retention compared to students taught using traditional instructional methods. The study also reported higher levels of student engagement and positive attitudes towards mathematics. Schoenfeld (1992) observed that meaningful mathematical learning depends upon opportunities for learners to explore different solution strategies, justify their reasoning, and reflect on their thinking processes. Activity-based classrooms naturally encourage such practices.

Indian Studies Related to Activity-Based Learning

In the Indian context, Activity-Based Learning has received increasing attention following curriculum reforms initiated by the National Curriculum Framework (2005). The framework recommended learner-centred pedagogy that encourages exploration, discussion, experimentation, and collaborative learning instead of rote memorisation.

Studies conducted by the National Council of Educational Research and Training (NCERT) have consistently emphasised the importance of joyful learning experiences in primary mathematics

classrooms. Classroom activities involving games, puzzles, manipulatives, projects, and locally available teaching-learning materials have been found to enhance children's conceptual understanding and interest in mathematics. The National Curriculum Framework (2005) advocated reducing curriculum load while increasing opportunities for learners to construct knowledge through meaningful classroom experiences. It recommended integrating mathematical concepts with children's daily experiences and encouraging teachers to design activity-oriented learning environments. The National Education Policy (2020) further strengthened this vision by emphasising experiential learning, competency-based education, inquiry-based instruction, and flexible pedagogical practices. The policy recognised that conceptual understanding develops more effectively through activity-based approaches than through memorisation of procedures.

Several state governments introduced Activity-Based Learning programmes in primary schools with encouraging results. Studies conducted in Tamil Nadu reported improved classroom participation, better attendance, enhanced learner motivation, and increased academic achievement among primary school children following implementation of Activity-Based Learning strategies. Research undertaken by various teacher education institutions has also shown that low-cost teaching-learning materials prepared from locally available resources significantly improve children's understanding of mathematical concepts. Activities involving paper folding, number games, measurement exercises, geometrical constructions, puzzles, and role play have been found particularly effective at the elementary level. Studies focusing on teacher perceptions indicate that most primary teachers acknowledge the benefits of Activity-Based Learning. However, they also identify several implementation challenges including shortage of instructional materials, limited classroom time, inadequate teacher preparation, overcrowded classrooms, and examination-oriented teaching practices.

Research on Learning Outcomes in Primary Mathematics

Learning outcomes have become an important indicator of educational quality. Rather than focusing only on curriculum completion, recent educational reforms emphasise whether learners actually acquire the expected competencies.

Research consistently indicates that conceptual understanding contributes significantly to improved learning outcomes in mathematics. Students who participate actively in classroom activities demonstrate better retention, higher achievement, greater confidence, and improved problem-solving abilities than those taught primarily through lecture methods. Studies also indicate that classroom participation influences academic achievement. Learners who discuss mathematical ideas, explain their reasoning, manipulate concrete materials, and collaborate with peers develop stronger conceptual understanding than learners who merely observe teacher demonstrations. Another important finding emerging from previous research is that mathematics anxiety decreases when classrooms become interactive and activity-oriented. Children experience less fear of making mistakes because learning becomes collaborative rather than competitive. Consequently, learners develop positive attitudes towards mathematics and greater willingness to attempt challenging problems.

Research Gap

Although considerable literature supports Activity-Based Learning, several gaps remain evident.

First, many available studies have focused on upper primary or secondary school students, whereas comparatively fewer investigations have examined its effectiveness among children in the early primary grades.

- Second, numerous studies discuss Activity-Based Learning conceptually without systematically measuring improvements in learning outcomes through classroom-based interventions.

- Third, much of the available research has been conducted under large-scale programmes, while relatively limited evidence is available from classroom action research undertaken by practising teachers in authentic school settings.
- Fourth, many studies focus primarily on academic achievement without examining related outcomes such as learner participation, confidence, classroom interaction, and attitudes towards mathematics.
- Finally, there remains a need to generate context-specific evidence demonstrating how activity-oriented pedagogical practices can be effectively implemented using locally available teaching-learning materials in ordinary elementary schools.

The present study attempts to address these gaps by examining the effectiveness of Activity-Based Approaches in enhancing the learning outcomes of Grade 3 students in selected topics of mathematics through a systematic classroom intervention conducted during the academic session 2019–2020.

Rationale of the Study

The primary years constitute a critical period for developing children's mathematical understanding. Experiences acquired during these years significantly influence later achievement, confidence, and interest in mathematics. Therefore, improving the quality of mathematics teaching at the elementary level remains an important educational priority.

Traditional classroom practices often encourage memorisation of rules and procedures rather than conceptual understanding. Such approaches may enable students to perform routine computations but seldom develop reasoning, problem-solving, creativity, or mathematical communication. Consequently, many children gradually develop anxiety and negative attitudes towards mathematics.

Activity-Based Learning offers an alternative instructional approach that actively engages learners in constructing mathematical concepts through meaningful classroom experiences. However, successful implementation requires empirical evidence demonstrating its effectiveness under actual classroom conditions.

The present study is significant because it provides classroom-based evidence regarding the impact of Activity-Based Learning on students' academic achievement and participation. The findings may assist teachers in selecting effective pedagogical strategies for primary mathematics classrooms. Teacher educators may utilise the findings while designing pre-service and in-service training programmes. Curriculum developers may incorporate similar activities into mathematics textbooks and teacher handbooks. Educational administrators may also use the findings while planning programmes for improving learning outcomes in elementary schools.

Furthermore, the study demonstrates that effective mathematics teaching does not necessarily require expensive instructional materials. Carefully planned activities using simple, low-cost, and locally available resources can significantly improve children's learning experiences and academic achievement.

Objectives of the Study

The study was conducted with the following objectives:

1. To assess the learning outcomes of Grade 3 students in selected topics of mathematics before the implementation of Activity-Based Approaches.
2. To develop and implement Activity-Based instructional strategies for teaching selected mathematical concepts.
3. To compare the learning outcomes of students before and after the classroom intervention.

4. To study the effect of Activity-Based Learning on students' classroom participation and engagement.
5. To examine the effectiveness of low-cost teaching-learning materials in promoting conceptual understanding of mathematics.

Research Questions

The study sought answers to the following questions:

1. What is the achievement level of Grade 3 students before the implementation of Activity-Based Learning?
2. Does Activity-Based Learning significantly improve students' learning outcomes in mathematics?
3. How does Activity-Based Learning influence students' classroom participation and engagement?
4. What are the perceptions of students regarding Activity-Based mathematics learning?

Hypotheses

The following null hypotheses were formulated:

1. There is no significant difference between the mean pre-test and post-test achievement scores of Grade 3 students taught through Activity-Based Approaches.
2. Activity-Based Learning does not significantly influence classroom participation of Grade 3 students.

Operational Definitions

Activity-Based Learning: A learner-centred instructional approach in which mathematical concepts are taught through carefully planned classroom activities involving exploration, manipulation of concrete materials, games, collaborative learning, observation, discussion, and problem-solving.

Learning Outcomes: The knowledge, understanding, skills, and competencies acquired by students as measured through teacher-developed achievement tests and classroom performance.

Primary Mathematics: Mathematics taught at the elementary stage, specifically selected topics prescribed for Grade 3.

Classroom Participation: The extent to which students actively engage in classroom discussions, activities, collaborative tasks, questioning, and problem-solving during mathematics lessons.

Methodology

Research Design: The study adopted an action research Design using a one-group pre-test–post-test approach to examine the effectiveness of Activity-Based Learning (ABL) in improving the mathematics learning outcomes of Grade III students. The study was conducted during the academic session 2019–2020 in a natural classroom setting, with the intervention integrated into the regular mathematics curriculum. Selected mathematical concepts were taught through activity-based strategies, including hands-on activities, games, manipulatives, collaborative tasks, and problem-solving exercises. Quantitative data were collected using teacher-developed pre-test and post-test achievement tests, while qualitative evidence was obtained through classroom observations, students' participation records, and teacher reflective notes. The integration of quantitative and qualitative data enabled a comprehensive evaluation of the effectiveness of the Activity-Based Learning intervention.

Variables of the Study

- Independent Variable: Activity-Based Approaches employed for teaching selected topics of mathematics.
- Dependent Variable: Learning outcomes of Grade 3 students as measured through achievement tests and classroom participation.
- Control Variables: To minimise the influence of external factors, the following variables were kept constant throughout the intervention: Same teacher, Same classroom environment, Same syllabus, Same instructional time, Same academic session, and Same assessment procedure

***Population*:** The population of the study comprised all Grade 3 students studying in elementary schools. Since the purpose of action research is to solve a specific classroom problem, the investigation was confined to one selected elementary school during the academic session 2019–2020.

***Sample*:** The sample consisted of 35 students enrolled in one section of Grade 3 of the selected elementary school. The Grade included learners with varying achievement levels, learning abilities, and socio-economic backgrounds. Such diversity provided an appropriate context for examining the effectiveness of Activity-Based Learning under normal classroom conditions. The sample was selected using the purposive sampling technique, as the researcher intended to improve the teaching-learning process within his own instructional setting. Purposive sampling is widely used in action research because the primary objective is classroom improvement rather than generalisation to a larger population.

Selection of Mathematical Topics

The intervention focused on selected topics from the prescribed Grade 3 Mathematics curriculum that generally pose conceptual difficulties for learners.

The selected topics included:

- Number concepts and place value
- Addition and subtraction
- Multiplication and division
- Fractions
- Measurement
- Time
- Money
- Geometrical shapes
- Patterns
- Simple problem solving

These topics were chosen because they provide ample opportunities for organising hands-on classroom activities using concrete materials.

Development of the Activity-Based Intervention

The Activity-Based instructional programme was developed after a detailed analysis of the curriculum, learning outcomes prescribed for Grade 3 , and children's developmental characteristics.

Each lesson was redesigned to include structured activities that promoted exploration, discussion, observation, reasoning, and collaborative learning.

The activities were planned according to the following principles:

- learner participation
- learning by doing
- concrete to abstract progression

- individual and group learning
- problem solving
- continuous assessment
- joyful learning

Wherever possible, low-cost and locally available teaching-learning materials were utilised.

Teaching-Learning Materials

A variety of instructional materials were prepared and used during the intervention.

These included:

- Number cards
- Flash cards
- Place value charts
- Matchsticks
- Bottle caps
- Beads
- Paper strips
- Geometrical shapes
- Fraction circles
- Measurement tapes
- Clock models
- Coins and currency notes
- Dice
- Playing cards
- Graph papers
- Worksheets
- Mathematical puzzles
- Activity sheets

The use of these materials enabled learners to visualise abstract concepts through concrete experiences.

Classroom Activities

Different classroom activities were organised depending upon the learning objectives of each lesson.

Number Concepts

Students prepared numbers using place value cards.

They represented numbers using bundles of sticks and beads.

Games involving ordering and comparing numbers were conducted.

Addition and Subtraction

Students solved practical problems using bottle caps and counters.

Group competitions were organised for mental computation.

Children explained different strategies used for obtaining answers.

Multiplication

Repeated addition activities were conducted using beads and matchsticks.

Students formed equal groups using classroom objects.

Skip-counting games were organised.

Division

Sharing activities using chocolates, pencils and counters were conducted.

Children discovered the concept of equal distribution through group work.

Fractions

Paper folding activities were organised.

Students divided fruits, paper circles and rectangles into equal parts.

Fraction cards were matched with pictorial representations.

Measurement

Students measured classroom objects using rulers, measuring tapes and hand spans.

Activities included estimation followed by actual measurement.

Time

Clock models prepared from cardboard were used.

Students demonstrated different timings by moving the hands of the clock.

Money

Role-play activities were organised in the form of a classroom market.

Students purchased and sold classroom materials using artificial currency.

Geometry

Students identified geometrical shapes in classroom surroundings.

Paper cutting and paper folding activities were conducted.

Children created different designs using geometric figures.

Patterns

Students developed patterns using coloured beads, leaves, sticks and paper strips.

Number patterns and shape patterns were explored through group activities.

Duration of the Intervention

The intervention was implemented over **eight weeks** during regular mathematics periods.

Approximately four mathematics periods per week were utilised for Activity-Based Learning.

Each lesson followed a systematic sequence comprising:

- Introduction
- Motivation
- Activity
- Discussion
- Concept formation
- Practice
- Reflection
- Assessment

This structure ensured continuity and consistency throughout the intervention.

Research Tools

The following tools were employed for data collection.

Achievement Test

A teacher-made achievement test covering the selected mathematical concepts was developed.

The test consisted of objective and short-answer questions designed to assess conceptual understanding, procedural knowledge and application.

The same test was administered as both the pre-test and post-test with an adequate time gap.

Observation Schedule

A structured classroom observation schedule was prepared to record learner participation.

The schedule included indicators such as:

- participation in activities
- asking questions
- responding to teacher questions
- group interaction
- use of teaching-learning materials
- confidence
- completion of assigned tasks

Classroom Participation Record

Students' participation during classroom activities was systematically documented.

Special attention was given to:

- willingness to participate
- cooperation
- leadership
- mathematical communication
- creativity
- problem-solving behaviour

Teacher Reflective Diary

The researcher maintained a reflective diary throughout the intervention.

The diary included observations regarding:

- classroom atmosphere
- student engagement
- difficulties encountered
- successful strategies
- modifications introduced
- personal reflections

The reflective diary served as an important qualitative source for interpreting the findings.

Validity of the Tools

The achievement test, observation schedule and activity sheets were examined by experienced teacher educators and mathematics education experts.

Necessary modifications were incorporated based on their suggestions to ensure content validity.

The classroom activities were also reviewed to ascertain their appropriateness for Grade 3 learners.

Reliability of the Achievement Test

The reliability of the teacher-made achievement test was established through a pilot administration involving students of similar characteristics.

Appropriate modifications were made after analysing item difficulty and discrimination indices.

The final test demonstrated satisfactory reliability for classroom research.

Procedure of Data Collection

The study was conducted in the following stages.

Stage I: Identification of learning difficulties experienced by Grade 3 students.

Stage II: Administration of the pre-test.

Stage III: Analysis of students' performance.

Stage IV: Planning Activity-Based lessons.

Stage V: Preparation of teaching-learning materials.

Stage VI: Implementation of the intervention over eight weeks.

Stage VII: Continuous classroom observation.

Stage VIII: Administration of the post-test.

Stage IX: Compilation and analysis of quantitative and qualitative data.

Stage X: Interpretation of findings and preparation of the research report.

Techniques of Data Analysis

The collected data were analysed using both descriptive and inferential statistics.

The following statistical techniques were employed.

- Mean
- Standard Deviation
- Percentage
- Gain Score
- Paired t-test

The qualitative observations recorded during classroom activities were analysed thematically to support the quantitative findings.

Ethical Considerations

The study adhered to accepted ethical practices in educational research.

Permission for conducting the classroom intervention was obtained from the school authorities.

Students were informed that the activities formed part of their regular classroom learning, and confidentiality of individual performance was maintained throughout the study. Data were used exclusively for academic and research purposes, and no learner was disadvantaged as a result of participation.

Limitations of the Methodology

The study was subject to certain limitations.

First, the investigation was confined to one section of Grade 3 in a single elementary school; therefore, the findings cannot be generalised to all primary schools.

Second, the duration of the intervention was limited to eight weeks, and a longer implementation might have produced additional insights into sustained learning gains.

Third, the study focused on selected topics of mathematics rather than the entire curriculum.

Finally, the action research design emphasised improvement of classroom practice within a specific context rather than broad statistical generalisation.

Results and Discussion

The purpose of the present study was to examine the effectiveness of Activity-Based Approaches in enhancing the learning outcomes of Grade 3 students in selected topics of mathematics. Data collected through achievement tests, classroom observations, participation records and the teacher's reflective diary were analysed using appropriate statistical techniques. The findings are presented objective-wise.

Achievement of Students Before the Intervention

A pre-test was administered before the implementation of the Activity-Based instructional programme to determine the initial level of students' understanding of the selected mathematical concepts.

Table 1: Pre-test Achievement Scores of Grade 3 Students (N = 35)

Achievement Level	Score Range	Number of Students	Percentage
High	21–25	5	14.29
Average	16–20	11	31.43
Low	11–15	13	37.14
Very Low	0–10	6	17.14
Total		**35**	**100.00**

The data indicate that only 14.29% of the students achieved high scores in the pre-test, whereas more than half of the Grade (54.28%) belonged to the low and very low achievement categories. This finding suggested that many learners had not yet developed a clear conceptual understanding of the selected mathematical topics.

Classroom observations during the pre-test stage further revealed that several students relied on memorisation of procedures without understanding the underlying concepts. Many learners hesitated to answer questions, avoided solving problems independently, and showed limited confidence while explaining their reasoning. These observations highlighted the need for a learner-centred instructional intervention.

Comparison of Pre-test and Post-test Achievement

After completion of the eight-week Activity-Based instructional programme, the same achievement test was administered as a post-test.

Table 2: Comparison of Pre-test and Post-test Scores

Test	Mean	Standard Deviation
Pre-test	13.94	3.12
Post-test	21.37	2.41
Mean Gain	**7.43**	

The comparison shows a substantial increase in the mean achievement score after the intervention. The mean score increased from 13.94 in the pre-test to 21.37 in the post-test, representing an average gain of 7.43 marks.

The reduction in the standard deviation also indicates that the variation among students decreased after the intervention. This suggests that Activity-Based Learning not only improved overall achievement but also enabled lower-achieving learners to perform closer to the Grade average.

Test of Significance

To determine whether the observed improvement was statistically significant, a paired *t*-test was employed.

Table 3: Paired t-test for Pre-test and Post-test Scores

Variable	Mean Difference	t-value	Level of Significance
Pre-test vs Post-test	7.43	11.86	Significant at 0.01 level

The obtained *t*-value (11.86) was much higher than the critical value at the 0.01 level of significance. Therefore, the null hypothesis stating that there is no significant difference between the pre-test and post-test scores was rejected.

The result clearly indicates that the Activity-Based instructional programme produced a statistically significant improvement in students' learning outcomes.

Improvement in Achievement Levels

Table 4: Distribution of Students According to Achievement Levels Before and After the Intervention

Achievement Level	Pre-test (%)	Post-test (%)
High	14.29	54.29
Average	31.43	37.14
Low	37.14	8.57
Very Low	17.14	0.00

A marked shift in the distribution of achievement levels was observed after the intervention. The percentage of students in the high achievement category increased from **14.29%** to **54.29%**, while no student remained in the very low achievement category. This transition demonstrates the positive impact of Activity-Based Learning on students across different ability levels.

Classroom Participation

One of the major objectives of the study was to examine changes in classroom participation during Activity-Based instruction.

Table 5: Changes in Classroom Participation

Classroom Behaviour	Before Intervention	After Intervention
Asking questions	Limited	Frequent
Participation in discussions	Low	High
Group work	Occasional	Regular
Use of TLM	Rare	Active
Mathematical communication	Limited	Considerable
Confidence	Low	High

The observational data revealed substantial improvement in students' classroom engagement. During the intervention, children participated enthusiastically in group discussions, manipulated teaching-learning materials confidently, and willingly shared their ideas with peers. Learners who had previously remained silent became increasingly involved in classroom activities.

The findings indicate that Activity-Based Learning created an inclusive classroom environment where students felt encouraged to participate without fear of making mistakes.

Development of Conceptual Understanding

Classroom observations suggested that students developed stronger conceptual understanding of mathematical ideas after participating in activity-based lessons.

For example, the concept of fractions, which many students initially found difficult, became easier to understand when paper folding, fraction strips and circular models were used. Similarly, measurement activities conducted using rulers, measuring tapes and classroom objects enabled learners to understand units of measurement more meaningfully than through textbook exercises alone.

Students also demonstrated improved understanding of place value after representing numbers with bundles of sticks and place-value charts. Multiplication and division concepts became clearer through repeated addition and equal-sharing activities.

These findings suggest that concrete experiences helped learners bridge the gap between abstract mathematical symbols and real-life situations.

Learner Motivation and Interest

The teacher's reflective diary indicated noticeable changes in learners' attitudes towards mathematics during the intervention.

Initially, several students expressed hesitation in solving mathematical problems. As the intervention progressed, however, they began participating voluntarily in classroom activities and frequently requested additional mathematical games and puzzles.

Attendance during mathematics periods also improved. Students displayed greater curiosity, asked more questions, and demonstrated enthusiasm while completing worksheets and collaborative tasks.

These observations suggest that Activity-Based Learning transformed mathematics from a subject associated with fear into an enjoyable and meaningful learning experience.

Teacher Reflections

The reflective diary maintained throughout the intervention highlighted several positive changes in classroom teaching.

The teacher observed that:

- learners understood concepts more quickly when concrete materials were used;
- classroom discipline improved because students remained actively engaged;
- peer learning became an important source of conceptual clarification;
- formative assessment became easier through continuous observation of learners during activities;
- students exhibited greater confidence while explaining mathematical ideas.

At the same time, the teacher also identified practical challenges such as preparing activity materials, managing time effectively, and organising group work within the available classroom space. Nevertheless, the educational benefits outweighed these operational difficulties.

Discussion

The findings of the present study clearly demonstrate that Activity-Based Approaches significantly enhanced the learning outcomes of Grade 3 students in mathematics. The substantial increase in post-test achievement scores, coupled with improved classroom participation and conceptual understanding, indicates that learner-centred instructional strategies are more effective than traditional lecture-based methods for teaching mathematics at the primary stage.

The improvement in achievement may be attributed to several features of the intervention. First, the use of concrete teaching-learning materials enabled students to visualise abstract concepts and construct mathematical meaning through direct experience. Second, collaborative group activities encouraged discussion, explanation and peer learning, thereby strengthening conceptual understanding. Third,

continuous interaction between the teacher and learners provided immediate feedback and opportunities for correcting misconceptions during the learning process.

These findings are consistent with constructivist theories of learning, which emphasise that knowledge is actively constructed through meaningful experiences rather than transmitted passively. The progression from concrete manipulation to symbolic representation observed during the intervention reflects the developmental principles proposed by Piaget and Bruner. Similarly, collaborative activities and teacher guidance align with Vygotsky's view that social interaction plays a central role in cognitive development.

The findings are also in agreement with earlier research demonstrating that activity-oriented pedagogy improves conceptual understanding, learner motivation and mathematical achievement. Previous studies have reported that students participating in hands-on learning experiences demonstrate greater confidence, stronger problem-solving skills and more positive attitudes towards mathematics than students taught through conventional methods. The present study provides further evidence supporting these conclusions within the context of Grade 3 mathematics.

Another important finding is that Activity-Based Learning appeared particularly beneficial for low-achieving learners. The reduction in score variability and the absence of students in the very low achievement category after the intervention suggest that active participation, peer support and continuous formative feedback helped bridge learning gaps. This has important implications for inclusive classrooms, where learners with varying abilities need opportunities to progress together.

Furthermore, the study demonstrates that effective activity-based mathematics teaching does not necessarily require sophisticated infrastructure or expensive equipment. Most of the activities were implemented using inexpensive and locally available materials such as bottle caps, paper strips, matchsticks, beads, cardboard clocks and classroom objects. This finding is particularly relevant for government and resource-constrained schools, where teachers often perceive a lack of materials as a barrier to implementing learner-centred pedagogy.

Overall, the findings reinforce the view that Activity-Based Learning is not merely an alternative instructional technique but a comprehensive pedagogical approach that promotes conceptual understanding, active engagement, collaborative learning and improved learning outcomes. The evidence generated through this classroom-based action research supports the integration of activity-oriented teaching practices into primary mathematics classrooms and aligns with the broader educational goal of creating joyful, meaningful and learner-centred learning environments.

Educational Implications

The findings of the present study have important implications for classroom practice, teacher education, curriculum development, school administration and educational policy. The significant improvement in students' learning outcomes following the implementation of Activity-Based Approaches demonstrates that learner-centred pedagogies can substantially strengthen mathematics learning at the primary stage.

Implications for Classroom Teachers: The study indicates that mathematics becomes more meaningful and enjoyable when children actively participate in learning rather than passively receive information. Teachers should therefore organise classroom instruction around carefully planned activities that encourage learners to observe, manipulate, discuss, compare, estimate, reason and solve problems collaboratively. Such instructional practices help children develop conceptual understanding while simultaneously improving communication skills, confidence and creativity.

The findings further suggest that teachers need not depend upon expensive teaching aids. Many mathematical concepts can be effectively taught using low-cost and locally available materials such as bottle caps, sticks, paper strips, beads, cards, measuring tapes, coins and classroom objects. The creative use of such resources can make mathematics classrooms interactive even in schools with limited infrastructure.

Continuous observation during activities also enables teachers to assess students' understanding more effectively than traditional written tests alone. Formative assessment integrated with classroom activities provides immediate feedback and helps teachers identify misconceptions at an early stage.

Implications for Teacher Education: Teacher education institutions should provide greater emphasis on Activity-Based Learning during both pre-service and in-service programmes. Student teachers need opportunities to design classroom activities, prepare low-cost teaching-learning materials, organise collaborative learning situations and conduct reflective classroom practice. Training programmes should also strengthen teachers' competencies in classroom management, activity planning, learner assessment and reflective teaching so that Activity-Based Learning can be implemented effectively under diverse school conditions.

Implications for Curriculum Developers: Curriculum developers and textbook writers should incorporate a larger number of activity-oriented tasks within mathematics textbooks and teacher handbooks. Learning outcomes should be supported by structured classroom activities, games, puzzles, projects and real-life applications that promote conceptual understanding rather than rote memorisation. Teacher manuals should include detailed guidelines for conducting classroom activities, suggested teaching-learning materials, assessment rubrics and alternative strategies for learners with different abilities.

Implications for School Leaders: School heads play an important role in creating an environment conducive to Activity-Based Learning. They should encourage teachers to adopt innovative pedagogical practices, facilitate collaborative lesson planning and ensure the availability of basic teaching-learning materials. Regular classroom observations and professional discussions may help teachers improve the quality of activity-oriented instruction.

Implications for Educational Policy: The findings support national efforts to promote learner-centred and competency-based education in elementary schools. Educational authorities should encourage schools to integrate Activity-Based Learning into regular classroom practice by providing appropriate teacher support, academic supervision and instructional resources. Continuous professional development programmes focusing on experiential and activity-oriented pedagogy may contribute significantly to improving learning outcomes in mathematics.

Recommendations

Based on the findings of the study, the following recommendations are proposed:

1. Activity-Based Learning should be integrated into the regular teaching of mathematics at the primary stage.
2. Teachers should utilise locally available and low-cost teaching-learning materials to promote conceptual understanding.
3. Teacher education programmes should provide systematic training in planning and implementing activity-oriented lessons.
4. Continuous and comprehensive assessment strategies should be integrated with classroom activities to monitor students' learning progress.
5. Schools should establish mathematics resource corners containing manipulatives, games, puzzles and other instructional materials.
6. School leaders should encourage collaborative planning among teachers to develop innovative classroom activities.
7. Curriculum developers should incorporate more experiential learning tasks into mathematics textbooks and teacher guides.

8. Educational authorities should organise regular capacity-building programmes on learner-centred pedagogical approaches for elementary school teachers.

Limitations of the Study

Although the study yielded encouraging findings, certain limitations should be acknowledged.

The investigation was confined to a single section of Grade 3 in one elementary school. Consequently, the findings may not be generalised to all school contexts without appropriate caution.

The duration of the intervention was limited to approximately eight weeks. A longer period of implementation might provide deeper insights into the sustained impact of Activity-Based Learning on learners' achievement and attitudes.

The study focused only on selected topics of the Grade 3 mathematics curriculum. Future investigations may extend similar interventions to the entire curriculum.

The action research design primarily emphasised improvement of classroom practice rather than broad statistical generalisation.

Conclusion

The present study examined the effectiveness of Activity-Based Learning (ABL) in improving the mathematics learning outcomes of Grade III students. The findings demonstrated that the systematic use of learner-centred instructional activities significantly enhanced students' academic achievement, conceptual understanding, classroom participation, and confidence in learning mathematics. The improvement in post-test scores indicated that students learned mathematical concepts more effectively when they were actively involved in hands-on activities, collaborative learning, games, and problem-solving tasks rather than passive listening.

Classroom observations further revealed increased enthusiasm, curiosity, and positive attitudes towards mathematics, suggesting that activity-oriented instruction created an engaging and joyful learning environment. The study also established that ABL can be implemented successfully using simple and locally available teaching-learning materials, making it a practical and cost-effective approach for primary schools. Continuous classroom observation and formative assessment enabled the teacher to identify learning difficulties and provide timely support to students.

Overall, the study concludes that Activity-Based Learning is an effective pedagogical strategy for primary mathematics education. It promotes meaningful learning, active engagement, and conceptual understanding while reducing dependence on rote memorisation. The findings support the integration of activity-based pedagogy into regular classroom practices, teacher education programmes, and curriculum implementation to improve mathematics learning outcomes and foster positive attitudes towards the subject.

References

Bruner, J. S. (1966). *Toward a theory of instruction*. Harvard University Press.

Boaler, J. (2002). *Experiencing school Mathematics*. Lawrence Erlbaum Associates.

Dewey, J. (1938). *Experience and education*. Macmillan.

Hiebert, J., & Carpenter, T. P. (1992). Learning and teaching with understanding. In D. A. Grouws (Ed.), *Handbook of Research on Mathematics Teaching and Learning* (pp. 65–97). Macmillan.

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Prentice Hall.

Kilpatrick, J., Swafford, J., & Findell, B. (Eds.). (2001). *Adding it up: Helping children learn Mathematics*. National Academy Press.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school Mathematics*. NCTM.

National Council of Educational Research and Training. (2005). *National curriculum framework 2005*. New Delhi: NCERT.

National Council of Educational Research and Training. (2006). *Position paper on teaching of Mathematics*. New Delhi: NCERT.

National Council of Educational Research and Training. (2018). *Learning outcomes at the elementary stage*. New Delhi: NCERT.

Ministry of Education. (2020). *National education policy 2020*. Government of India.

Piaget, J. (1970). *Science of education and the psychology of the child*. Viking Press.

Polya, G. (1957). *How to solve it* (2nd ed.). Princeton University Press.

Schoenfeld, A. H. (1992). Learning to think mathematically. In D. A. Grouws (Ed.), *Handbook of Research on Mathematics Teaching and Learning* (pp. 334–370). Macmillan.

Skemp, R. R. (1987). *The psychology of learning Mathematics*. Lawrence Erlbaum Associates.

Vygotsky, L. S. (1978). *Mind in society: The Development of Higher Psychological Processes*. Harvard University Press.

Ernest, P. (1991). *The philosophy of Mathematics Education*. Falmer Press.

Freudenthal, H. (1973). *Mathematics as an educational task*. D. Reidel.

Niss, M. (1994). Mathematics in Society. In R. Biehler et al. (Eds.), *Didactics of Mathematics as a Scientific Discipline*. Kluwer Academic Publishers.

Bishop, A. J. (1988). *Mathematical enculturation*. Kluwer Academic Publishers.

***