CHAPTER- 3

RESEARCH METHODOLOGY

3. RESEARCH METHODOLOGY

3.1. Introduction

This chapter presents a comprehensive outline of the research methodology employed to investigate the Impact of Game-Based Pedagogy on the Achievement of Students in Mathematics at the Middle Stage. The methodology has been designed to ensure scientific rigor, relevance, and validity in addressing the research objectives. It elaborates on the research design, variables, population and sampling framework, data collection procedures, tools and techniques, and scoring system. The structured methodology ensures that the study systematically explores whether game-based pedagogy can significantly enhance student performance in mathematics.

3.2. Research Design

The study is grounded in a quasi-experimental research method, specifically utilizing a non-equivalent pre-test–post-test control group design. This approach was deemed suitable as the assignment of students to groups was based on pre-existing class divisions, thereby avoiding disruption to regular academic structures while still enabling comparative analysis.

The quasi-experimental design enables the researcher to:

- Assess the effectiveness of an intervention (game-based pedagogy)
- Establish a cause-effect relationship by comparing learning gains
- Observe the differences between two instructional methods over time

Design Framework

Group	Pre-Test	Intervention	Post-Test
Experimental (A)	Yes	Game-Based Pedagogy	Yes
Control (B)	Yes	Traditional Pedagogy	Yes

This structure provided measurable insights into student achievement gains attributable to the game-based instructional approach.

3.3. Variables of the Study

The study involved the following categories of variables:

- **Independent Variable:**
  - **Game-Based Pedagogy** – An instructional method integrating structured mathematical games, puzzles, and interactive group activities, aiming to promote engagement, conceptual clarity, and retention in mathematics learning.
- **Dependent Variable:**
  - **Mathematics Achievement –** Measured through performance scores obtained in the pre-test and post-test assessments designed around the topic of Mensuration, as prescribed in the NCERT Class 8 curriculum.
- **Controlled Variables:** To maintain internal validity, the following elements were held constant across groups:
  - Curriculum content (same mathematics unit: Mensuration)
  - Instructional duration (same number of teaching hours for both groups)
  - Teacher (same instructor delivered both modes of instruction)
  - Classroom time and physical environment

3.4. Population and Sample

3.4.1. Population

The population for this research comprised all students enrolled in Class 8 at DMS School, Bhopal, a reputed institution affiliated with a national curriculum board. The students shared a common academic schedule and learning environment, reducing variability due to external factors.

3.4.2. Sample

The sample consisted of 70 students from Class 8, drawn from two intact sections:

- Section A (Experimental Group): 35 students exposed to game-based pedagogy
- Section B (Control Group): 35 students taught using traditional lecture-based methods

This purposive sampling technique was adopted to utilize the naturally existing classroom divisions while ensuring demographic and academic comparability between the two groups.

3.4.3. Rationale for Sample Selection

The selected sample ensured:

- Homogeneity in age group and curriculum exposure
- Comparable baseline academic performance
- Practical feasibility of classroom intervention
- Consistency in evaluation within a real classroom setting

3.5. Sample Size

The total sample size for the study was 70 students, equally distributed:

- Experimental Group: 35 students (Class 8, Section A)
- Control Group: 35 students (Class 8, Section B)

This sample size was adequate for conducting meaningful statistical analysis while maintaining practical manageability for classroom-based intervention and observation.

3.6. Data Collection Procedure

The data collection was conducted in a structured three-phase approach:

Phase I: Pre-Intervention (Baseline Assessment)

- Formal consent was obtained from the school administration, students, and parents.
- A mathematics pre-test was administered simultaneously to both groups under standardized conditions to assess initial competency levels in the selected unit (Mensuration).
- Students also completed a pre-intervention questionnaire assessing their interest and prior experience with learning mathematics.

Phase II: Instructional Intervention

- Over a period of six weeks, the teaching sessions were conducted during regular mathematics periods.

- **Experimental Group (Section A):**
    - Instructional content was delivered through structured game-based activities, including logic games, area-and-volume puzzles, group problem-solving games, and concept-driven competitions.
    - Students were grouped strategically to encourage peer learning and interaction.
- **Control Group (Section B):**
    - Instruction followed the conventional lecture-based method involving textbook explanations, individual problem solving, and chalk-and-talk strategies.
    - The researcher maintained a classroom observation log using a structured checklist to monitor student engagement, participation, and instructional fidelity.

Phase III: Post-Intervention (Outcome Assessment)

- After the completion of the instructional phase, a post-test of equivalent difficulty and content structure was administered to both groups.
- Students were also asked to fill out a post-intervention feedback questionnaire, designed to capture their perceptions of the learning experience, engagement level, and self-reported academic improvement.

3.7. Tools and Techniques

The study employed the following research tools:

3.7.1. Mathematics Achievement Test

- A teacher-developed test aligned with the Class 8 NCERT syllabus on Mensuration.
- Content areas included surface area, volume, perimeter, and related real-life applications.
- The test structure included:
    - 10 multiple-choice questions (1 mark each)
    - 5 short answer questions (2 marks each)
    - 3 long-form problem-solving questions (5 marks each)
- Total Score: 50 marks

- The test was validated by subject experts and piloted for reliability (Cronbach's alpha = 0.78).

3.7.2. Student Feedback Questionnaire

- Included 15 Likert-scale items (5-point scale) and 3 open-ended questions.
- Focused on:
    - Motivation and interest in mathematics
    - Enjoyment and participation during lessons
    - Perceived improvement in understanding and performance

3.7.3. Observation Schedule

- Used by the researcher during intervention to document:
    - Student attentiveness
    - Collaboration and group interaction
    - Responsiveness to game-based activities

3.8. Scoring Key

3.8.1. Achievement Test Scoring

Question Type	Marks per Item	Total Items	Total Marks
Multiple Choice Questions	1	10	10
Short Answer Questions	2	5	10
Problem-Solving Questions	5	3	15
Total	—	—	35

Scores were standardized and scaled to a 50-point format for uniformity in analysis.

3.8.2. Questionnaire Scoring

- Likert Scale Responses:
    - Strongly Agree = 5
    - Agree = 4
    - Neutral = 3
    - Disagree = 2
    - Strongly Disagree = 1

- Responses were compiled and subjected to descriptive statistical analysis (mean, mode, standard deviation).
- Open-ended responses were coded and analyzed thematically.

3.9. Ethical Considerations

- **Informed Consent:** Prior consent was obtained from school authorities, students, and parents.
- **Confidentiality:** Student identities and responses were kept strictly confidential and anonymized.
- **Non-Maleficence:** No group was academically disadvantaged; both received quality instruction aligned with the curriculum.
- **Voluntary Participation:** Students could opt out of the study at any time without academic consequences.

3.10. Summary

This chapter detailed the methodological framework underpinning the study. By employing a quasi-experimental design with clearly defined variables, validated tools, and ethical safeguards, the research aimed to systematically evaluate the impact of game-based pedagogy on student achievement in mathematics. The next chapter will present the analysis and interpretation of the data collected through the outlined procedures.