अधिगम
अंक 38 : मार्च 2026
ISSN : 2394-773X

"Enriching Foundational Mathematics through Embodied Pedagogical Approach: An Action Research"

Ms. Abhilasha Chaudhary*
Mr. Varish**

Abstract

Foundational Mathematics, encompassing concepts such as pre-number concepts, number sense, operations, spatial reasoning, geometry, measurement, and patterns, serves as the bedrock for all subsequent learning. However, conventional pedagogy often depends on rote memorization and abstract symbols, fostering disconnection and math anxiety among young learners. Research has proven the need and importance of providing an immersive learning experience in classrooms. In light of this National Education Policy 2020 and the National Curriculum Framework for Foundational Stages 2022 advocate for experiential, play-based learning, classroom instruction which certainly rely on embodied pedagogical approach. Embodied pedagogy, grounded in the theory

* Pre service Teacher, Department of Elementary Education, Lady Shri Ram College for Women, University of Delhi.
** Assistant Professor, Department of Elementary Education, Lady Shri Ram College for Women, University of Delhi

of embodied cognition, asserts that thinking is rooted in bodily action, movement, gesture, and sensory experience. The aim of present study was to identify the mathematical areas in the foundational stage curriculum where embodied pedagogical approaches can be implemented.

The researcher explored the conception of embodied pedagogy through action research design. This study was conducted with class I and II students of one of the KendriyaVidyalayas based in Delhi where the researcher is doing internship. In the cyclic process of action research activities and tasks were planned around the theme Yoga with Lines and Warli-Inspired art work. These themes covered foundational mathematical concepts such as geometric shapes, lines, patterns, symmetry, sequencing, addition, and subtraction through various gestures or motion using their own natural movements and environments as learning resources. When these tasks and activities were in action, the researcher collected the data through field notes, semi structured observations and photographic documentation. Reflective conversations were conducted to help the students use language to explain their movements and, in the process, make sense of associated concepts. It was observed that students were able to internalise and express mathematical concepts and abstract concepts were found to be more tangible. With these body-based activities, promoted social skills, mathematical learning becomes joyful, contextual, and deeply connected to the child's environment. The research suggests the need for child-sensitive and authentic assessment tools that capture understanding expressed through movement, gesture, and creative representation, thereby aligning pedagogy and assessment with the holistic, experiential vision outlined in India's national education policies.

Keywords: *Action Research, Embodied Cognition, Embodied Pedagogy, Experiential Learning, Foundational Stage, Mathematics, NCF-FS 2022, NEP 2020 and Play-Based Learning*

Introduction

Mathematics forms the foundation of logical reasoning, problem-solving, and analytical thinking. In the early years, it develops through experiences that are sensory, active, and contextual. However, in many traditional classrooms, mathematics is introduced through abstract numbers, rote memorization, and repetitive drills, which often alienate children and contribute to what is termed as math anxiety. Young learners struggle to connect abstract symbols with their lived reality, resulting in superficial understanding and disengagement.

The National Education Policy (NEP) 2020 and the National Curriculum Framework for Foundational Stage (NCF-FS) 2022 emphasize that learning, especially at the foundational level, must be experiential, play-based, and integrated across domains. Mathematics, too, must be taught in ways that invite curiosity, movement, and imagination. Within this vision, embodied pedagogy—which integrates bodily action, gesture, movement and sensory engagement into learning—emerges as a transformative approach.

The theory of embodied cognition, as discussed by scholars such as Lakoff and Núñez (2000), proposes that thinking is fundamentally rooted in physical experience. Our bodies, movements, and sensory perceptions shape how we conceptualize the world, including abstract ideas such as number, shape, and space. When applied to mathematics education, this perspective suggests that children can develop deeper understanding when they feel, act, and move

through mathematical concepts rather than only hearing or seeing them symbolically.

There are studies in different disciplines to explore the potentiality of embodied cognition in early years of schooling. Way and Ginns (2024) highlight that early mathematics learning is most effective when grounded in embodied experiences rather than abstract drills. Their review demonstrates that activities involving body movement, gesture, and physical manipulation improve understanding of number sense and spatial reasoning. They further discuss the translational gap between laboratory research and classroom implementation, proposing design principles for teachers to integrate embodied strategies into daily pedagogy.

Nemirovsky et al. (2017) explore how mathematical thinking is shaped by physical interaction with the environment. Their findings reveal that gestures and bodily actions enable learners to externalize thought and form concrete–to–abstract connections. The study also compares digital and non-digital contexts, suggesting that simple, tangible actions (like arranging shapes or moving objects) significantly aid conceptual formation.

Hegarty et al. (2016) explain that mathematical insight is promoted when learners use both action and language simultaneously. They found that combining bodily engagement (like tracing or posing shapes) with verbal reflection enhances memory and reasoning.

Spiro et al. (2023) conducted a scoping review establishing that movement experiences—such as running, bending, or positioning—strengthen spatial reasoning and geometric visualization among young children. Their work links bodily movement to the development of foundational mathematical ideas like measurement and symmetry.

Gordon and Ramani (2021) propose a combined model of embodied cognition and information processing, showing that

gesture serves both cognitive and communicative functions in mathematics learning. Their research demonstrates that children who use gestures during math tasks display deeper conceptual understanding and better problem-solving strategies. For teachers, this implies that observing and encouraging gestures can act as a formative assessment tool.

These studies and researches highlight that children in the foundational years—who naturally learn through play, touch, and movement—are often restricted by pedagogical methods that disconnect the body and mind. Considering this as the main stand point following action research-based study was conducted.

These studies and researches which encompasses multiple facets of embodied pedagogy and embodied cognition helped in devising a theoretical framework for the present study.

Theoretical Framework Of The Study

The study is grounded in the theory of Embodied Cognition (Varela, Thompson, &Rosch, 1991; Lakoff&Núñez, 2000), which asserts that cognition is deeply connected to physical experience. The framework suggests that abstract reasoning develops from sensorimotor experiences and that learning occurs when children use their bodies to represent, manipulate, and make sense of concepts.

In early mathematics education, this means that when children physically form lines through yoga postures, enact addition through jumps, or recreate shapes through art, they are not merely acting out lessons but constructing meaning through embodied experience. This integration of action, perception, and reflection bridges the gap between abstract symbols and lived experience.

This study defines embodied pedagogy as a teaching approach that integrates bodily movement, gestures, and sensory engagement into

learning, based on the idea that cognition is grounded in physical interaction with the environment.

Research Questions

The following are the research questions for the present study:

1. Which curriculum components in foundational mathematics lend themselves most meaningfully to embodied pedagogy?
2. How can embodied pedagogical strategies be implemented to enhance conceptual understanding and engagement in early mathematics classrooms?

Research Objectives

The objective of conducting this action research were :

1. To identify key areas of foundational mathematics that can be addressed through embodied pedagogy.
2. To design and implement embodied pedagogical activities in a real classroom setting.
3. To observe and analyse how bodily movement, gesture, and cultural art influence children's mathematical learning and expression.

Methodology

The research methodology is an important aspect of any study as it helps us in approaching any issue in a systematic way and producing an authentic data. This study relied on action research approach as the research was teaching these students.

Research Design

The research design of the study was action research. Creswell (2015) consider action research as one of the qualitative research designs. Action research is an approach to educational research that is commonly used by educational practitioners and professionals to examine, and ultimately improve, their pedagogy and practice. In this way, action research represents an extension of the reflection

and critical self-reflection that an educator employs on a daily basis in their classroom.

Action research design, enabling the teacher-researcher to examine and refine her teaching practices. It focused on integrating embodied pedagogical strategies into foundational mathematics teaching through four phase iterative cycles of planning, implementation, observation, and reflection. This study also identified some key areas where embodied pedagogy approach can be used, after this a series of task were planned and implemented in the classroom. The data presented in this study is from those action-oriented classroom observations and reflection.

Sample And Sampling

The study was conducted with around 60 students of Classes I and II from a KendriyaVidyalaya in Delhi, where the researcher was interning. A purposive sampling technique was used, as early learners were most suited for exploring embodied learning approaches further researcher was teaching these students in the internship days as allocated by college.

Tools of data Collection

There is a need for using multiple tools for data collection in action research for authenticity and credibility of the findings. The researcher used the following tools for data collection in this study:

- Semi-Structured Observations: to record gestures, expressions, and learning responses.
- Photographic Documentation: to capture students' embodied engagement and collaborative participation.
- Reflective Conversations: A brief post-activity discussion where students articulated what they learned through movement or art.

Analysis And Findings

The study was action research and hence the findings of the study are being presented here in the phase wise manner. There were four phases of the study and the findings from the study as follows:

Phase-I: Identity and Planning of task

The planning phase began with identifying curriculum areas from the NCERT Mathematics textbooks for Classes I and II where embodied pedagogy could be most effectively applied. Topics that naturally invited movement, gesture, and sensory engagement were selected — such as pre-number concepts, lines and shapes, patterns, spatial reasoning, and number operations.

For Class I, emphasis was on pre-number concepts (big–small, long–short, heavy–light), lines and shapes, and patterns. For Class II, focus extended to spatial reasoning, symmetry, and operations (addition and subtraction).

The mapping of content revealed that mathematics learning in the foundational years can be strongly enhanced through bodily involvement and cultural integration. Four embodied interventions were planned accordingly:

1. Yoga with Lines – linking geometry with bodily movement.
2. Warli-Inspired Art – exploring shapes, patterns, and symmetry through cultural art.
3. Tangram Using Hands – observation-based task promoting spatial reasoning and composition.
4. Number Line Movement – performing operations through body movement.

This planning aligned with the NCF-FS 2022 principle of play-based, experiential, and art-integrated learning, and drew theoretical grounding from research that views cognition as embodied (Way &Ginns, 2024; Nemirovsky et al., 2017).

Phase-II: Implementation

The implementation was carried out with about 60 students of Classes I and II in a KendriyaVidyalaya, Delhi, during the researcher's internship. The classroom was restructured as an interactive learning space where movement and expression were encouraged.

- Yoga with Lines: Students formed straight, slanting, curved, and zigzag lines using yogapostures. As they stretched, bent, or balanced, the teacher introduced vocabulary such as "horizontal," "vertical," and "curved."
- Warli-Inspired Art: Students explored shapes through Warli motifs. They used body postures to form triangles, circles, and lines, and then transferred these onto paper. The integration of body, art, and geometry deepened spatial awareness.
- Number Line Movement: A large number line was created on the floor. Children physically jumped forward for addition and backward for subtraction, chanting numbers aloud. Directional movement helped them visualize arithmetic operations.
- Tangram Using Hands (Observation-Based): Without using physical tangram pieces, students used their palms and fingers to form triangles, squares, and rectangles. They observed how two smaller shapes could make a larger one, building logical reasoning and visual–spatial sense.
- Pre-Number Concept Tasks (Observation-Based): Simple bodily activities like stretching high and crouching low (tall–short), taking long and short steps (long–short), or lifting light and heavy classroom items were introduced. These tasks embodied comparison and classification — crucial for pre-number understanding.

All activities reflected NEP 2020's call for joyful, integrated, and sensory-rich learning experiences that situate mathematics in lived experience.

Phase-III: Observation of Tasks (Researcher's Notes)

Observations recorded during sessions revealed consistent evidence of engagement, curiosity, and conceptual growth:

- In Yoga with Lines, students began identifying line types through body awareness. One child exclaimed, "This curved line is like a rainbow!" indicating conceptual understanding expressed through imagery and motion.
- In Warli Art, collaboration was visible — children discussed shape placement, saying "Your triangle is big, mine is small!" Their gestures mirrored their speech, reflecting embodied cognition.
- Number Line Movement made operations visible; children physically enacted addition and subtraction, reinforcing understanding through coordinated jumps and rhythmic counting.
- In Tangram Using Hands, children displayed reasoning through play. They combined smaller hand-formed triangles to create squares and rectangles, linking part–whole relations.
- Pre-Number Concept tasks showed how bodily comparison built early mathematical logic. Stretching tall, crouching short, and stepping long or short helped children feel quantity and difference.

Across all tasks, the researcher observed that physical engagement created multi-sensory learning—visual, auditory, and kinaesthetic—bridging action and abstraction. Learners who were previously hesitant in mathematics became participative and confident, showing reduced anxiety and improved retention.

Phase-IV: Reflection on the Taks

Reflection was conducted after each session through teacher journaling and short student discussions.

- Meaning-Making through Movement: Children recalled and described mathematical terms by re-enacting them. They remembered "slanting" by leaning sideways or "curved" by bending arms like a circle. This demonstrated internalization through body memory.
- Language Development: Post-activity discussions allowed children to articulate mathematical relationships in their own words. Terms like bigger, smaller, forward, backward, and equal appeared spontaneously.
- Social and Emotional Growth:Group-based art and movement tasks encouraged cooperation, empathy, and turn-taking—fulfilling NCF-FS goals of integrated socio-emotional learning.
- Teacher Reflection: The researcher recognized that bodily enactment is both a pedagogical tool and an assessment method. Observing gestures and expressions provided evidence of learning not captured in written tasks. The reflective cycle (plan–act–observe–reflect) strengthened professional insight, as advocated by action research literature.
- Link to Policy and Research: The embodied strategies validated the NEP 2020 and NCF-FS 2022 emphasis on experiential, art-integrated, and inclusive learning. They also resonated with theoretical frameworks of embodied cognition (Hegarty et al., 2016) and ethnomathematics (Wahyuni et al., 2023; Sharma et al., 2024), affirming that cognition develops through bodily, cultural, and sensory experience.

Conclusion

The conclusion of the study in light of using embodied pedagogy with foundational stage learner is as follows:

Objective 1: To identify key areas of foundational mathematics that can be addressed through embodied pedagogy

The study successfully identified curriculum areas in Classes I and II mathematics—such as pre-number concepts, lines and shapes, patterns, number operations, and spatial reasoning—that naturally lend themselves to embodied learning. These topics allowed the integration of bodily movement, gesture, and sensory experience into conceptual understanding. The mapping exercise revealed that embodied engagement deepens comprehension of abstract ideas, aligning with the NCF-FS 2022 emphasis on experiential and play-based pedagogy.

Objective 2: To design and implement embodied pedagogical activities in a real classroom setting

Four embodied interventions—Yoga with Lines, Warli-Inspired Art, Tangram Using Hands, and Number Line Movement—were designed and implemented with about 60 students. These activities transformed the classroom into an interactive, movement-based learning environment. Implementation showed that bodily expression, art integration, and play encouraged participation, curiosity, and confidence among learners. The interventions demonstrated practical feasibility and effectiveness of embodied pedagogy in early mathematics education.

Objective 3: To observe and analyse how bodily movement, gesture, and cultural art influence children's mathematical learning and expression

Observations indicated that movement and gesture enhanced conceptual clarity and retention. Children physically enacted mathematical concepts, expressed understanding through imagery,

and verbalized relationships meaningfully. Cultural integration through Warli art deepened spatial and aesthetic appreciation, while group tasks fostered collaboration and socio-emotional growth. Reflection showed that gesture-based learning supported both cognitive and linguistic development, as children used their bodies and words in tandem to construct meaning. The findings affirmed that embodied pedagogy not only develops mathematical understanding but also cultivates confidence, creativity, and inclusivity in learning.

This action research demonstrates that the body is not separate from the mind but integral to thinking. When mathematics is experienced through the body—through balance, rhythm, and creativity—it becomes meaningful, memorable, and joyful.

Embodied pedagogy support the holistic vision of NEP 2020 and NCF-FS 2022, nurturing children who learn not only to calculate but to feel and understand mathematics as part of their lived world.

Refrences

- Abramson, D. (2015). Embodied mathematics: The role of gesture and movement in children's mathematical thinking. The Mathematics Enthusiast, 12(3), 679–698. https://scholarworks.umt. edu/tme/ vol12/iss3/15
- Creswell, J. W. (2015). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (5th ed.). Pearson Education, Inc.
- Education Sciences.(2023). A play-responsive approach to teaching mathematics in preschool, with a focus on representations.Education Sciences, 15(8), 999. https://doi.org/ 10.3390/educsci15080099
- Gordon, R., &Ramani, G. B. (2021). Integrating embodied cognition and information processing: A combined model of the role of gesture in children's mathematical environments. Frontiers in Psychology, 12, 650286. https:// doi.org/10.3389/ fpsyg. 2021.650286

- Government of India.(2020). National Education Policy 2020.Ministry of Education, New Delhi. Retrieved from https:// www.education. gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf
- Hegarty, M., et al. (2016). Grounded and embodied mathematical cognition: Promoting mathematical insight and proof using action and language. Cognitive Research: Principles and Implications. https://doi.org/10.1186/s41235-016-0040-5
- Lakoff, G., &Núñez, R. (2000). Where mathematics comes from: How the embodied mind brings mathematics into being. New York: Basic Books.
- National Council of Educational Research and Training (NCERT).(2022). National Curriculum Framework for the Foundational Stage (NCF-FS 2022). New Delhi: NCERT.
- Nemirovsky, R., et al. (2017). Support of mathematical thinking through embodied cognition: Nondigital and digital approaches. Cognitive Research: Principles and Implications, 2(16). https://doi.org/ 10.1186/s41235-017-0053-8
- Sharma, A., Singh, S., & Kumar, V. (2024). Geometry in Warli: Merging folk art with mathematics teaching. ShodhKosh: Journal of Visual & Performing Arts, 5(1), 1629–1644. https://doi.org/10.29121/ shodhkosh.v5.i1.2024.1475
- Spiro, C., et al. (2023). The role of movement in young children's spatial experiences: A review of early childhood mathematics education research. Mathematics Education Research Journal, 35, 287–315. https://doi.org/10.1007/s13394-023-00446-0
- Varela, F. J., Thompson, E., &Rosch, E. (1991). The embodied mind: Cognitive science and human experience. Cambridge, MA: MIT Press.
- Wahyuni, I., Argareta, F. M., &Dewi, I. (2023).Ethnomathematics from a wide range of perspectives. Journal of Medives: Journal of Mathematics Education IKIP Veteran Semarang, 7(1). https://doi.org/10.31331/ medivesveteran.v7i1.2264
- Way, J., &Ginns, P. (2024). Embodied learning in early mathematics education: Translating research into principles to inform teaching. Education Sciences, 14(7), 696. https://doi.org/10.3390/educsci 14070696