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A Review on Activity-Based Teaching Strategies for Enhancing Science Concept Learning Among Grade IV Students

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Abstract: *Activity-based teaching has gained significant attention in primary education as an effective approach for improving science learning outcomes. For Grade IV students, hands-on activities, experiments, models, and inquiry-based learning help develop conceptual clarity in diverse science topics. This review paper analyses existing literature, pedagogical theories, and empirical studies related to activity-based learning (ABL) to evaluate its effectiveness in enhancing science concept learning among 60 Grade IV students. Findings across reviewed studies consistently demonstrate improvement in conceptual understanding, motivation, engagement, and retention when activity-based strategies are integrated into science teaching.*

Keywords: Activity-based, Learning, Science, Concepts, Grade-IV, Pedagogy

I. INTRODUCTION

Science learning at the primary level lays the foundation for logical thinking, curiosity, and conceptual understanding. Traditional lecture-based teaching often limits active participation and fails to stimulate conceptual development among young learners (Sharma, 2019). Activity-Based Learning has emerged as an alternative pedagogy that emphasizes learning by doing, promoting experiential learning, collaboration, and inquiry (Dewey, 1938; Kolb, 1984).

Grade IV students, typically between 9–10 years of age, learn best when engaged in concrete experiences rather than abstract explanations. Science topics such as states of matter, plants, animals, energy sources, and water cycle become more meaningful when taught through activities such as experiments, model-making, demonstrations, and group-based tasks. Studies show that activity-based teaching helps students strengthen conceptual understanding and apply scientific concepts in real-life contexts (Kumar & Kaur, 2020).

This review synthesizes research on activity-based teaching strategies implemented for Grade IV students specifically focusing on evidence from studies conducted on groups of 60 learners. The purpose is to examine how activity-based strategies enhance science concept learning and identify the most effective pedagogical approaches.

Science education at the primary level plays a crucial role in nurturing curiosity, fostering inquiry, and building foundational concepts that form the basis for advanced scientific learning. At the Grade IV level, students are in a developmental stage characterized by concrete thinking, active exploration, and a natural inclination toward hands-on engagement with their environment. This makes the traditional lecture-based, teacher-centered instructional methods insufficient for meaningful science learning, as young learners often struggle to grasp abstract scientific concepts without concrete experiences (Piaget, 1973). Consequently, educational researchers and practitioners have emphasized the adoption of activity-based teaching strategies, which promote learning through doing, experimentation, and interaction. Activity-based learning is rooted in constructivist educational theories, suggesting that learners construct knowledge most effectively through active participation and real-world experiences (Dewey, 1938; Bruner, 1961).

The primary goal of science education is not merely memorization of facts but the development of conceptual understanding, scientific reasoning, and the ability to apply knowledge in everyday contexts. Activity-based teaching strategies align with these objectives by enabling students to observe scientific phenomena firsthand, manipulate

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physical objects, and engage in inquiry-driven discussions. For Grade IV students, such strategies are especially beneficial because they help bridge the gap between concrete experiences and emerging abstract reasoning abilities (Kolb, 1984). Numerous studies have shown that when students participate in experiments, model-making, demonstrations, field activities, and collaborative problem-solving, their understanding of scientific concepts deepens significantly compared to traditional methods (Sharma, 2019; Nair, 2018).

Activity-based learning strategies also enhance student motivation and engagement, which are essential components for effective science learning. Young children often find science challenging or intimidating when taught solely through textbooks and verbal explanations. However, when learning involves hands-on activities, simple experiments, or group interactions, students demonstrate notably higher levels of participation, curiosity, and enthusiasm (Kumar & Kaur, 2020). Increased engagement also contributes to improved retention of concepts. Research indicates that experiential and inquiry-based activities lead to long-term memory formation because students actively connect new information with prior knowledge and real-world experiences (Chi & Wylie, 2014). Furthermore, activity-based methods provide opportunities for collaborative learning, where students discuss observations, share ideas, and learn from peers. This social dimension of learning is consistent with Vygotsky's socio-cultural theory, which posits that interaction plays a key role in cognitive development (Vygotsky, 1978).

In the context of Grade IV science education, activity-based strategies are particularly relevant due to the nature of the curriculum. Topics such as states of matter, plant and animal life, weather, energy sources, and simple machines lend themselves effectively to hands-on exploration. Activities like observing evaporation, creating seed germination experiments, building simple circuits, or making models of the water cycle enable students to directly experience the concepts under study (Patel, 2021). These experiential activities foster conceptual clarity, correct misconceptions, and encourage scientific thinking. For example, students may hold misconceptions about processes like evaporation or germination, but when they observe these phenomena through guided experiments, they develop accurate understanding supported by evidence. This aligns with the constructivist belief that misconceptions are best addressed through active engagement and observable experiences rather than passive instruction.

The shift toward activity-based science teaching is also driven by changes in educational policy and curriculum frameworks. The National Curriculum Framework emphasizes learning that is joyful, experiential, and child-centered, particularly at the primary level. The framework advocates replacing rote memorization with inquiry-based and activity-rich learning environments that cultivate critical thinking and problem-solving skills. In many classrooms, however, the transition from traditional teaching to activity-based strategies remains slow due to challenges such as insufficient resources, lack of teacher training, and large class sizes. Nevertheless, empirical studies reveal that even simple low-cost activities can produce significant improvements in learning outcomes when implemented effectively (Rao & Reddy, 2019). This demonstrates that activity-based learning does not necessarily require expensive materials but rather creative teaching approaches and supportive learning environments.

The review of activity-based strategies further highlights the importance of aligning instructional activities with learning objectives and student needs. Effective ABL involves carefully planned activities that encourage observation, questioning, classification, prediction, and reasoning. It also requires the teacher to act as a facilitator who guides students through inquiry, encourages exploration, and provides scaffolding when necessary. In Grade IV science classrooms, teachers who integrate guided inquiry where students are allowed to ask questions, explore materials, and build their own explanations often report substantial gains in student understanding and interest (Singh & Mehta, 2020). This supports the notion that active participation not only enhances cognitive outcomes but also contributes to the development of scientific attitudes such as curiosity, perseverance, and openness to new ideas.

Another significant aspect of activity-based teaching is its role in reducing learning disparities. Students differ widely in their learning styles some learn best through visual experiences, others through kinesthetic activities or social interaction. Activity-based learning accommodates these diverse learning preferences by offering multiple pathways to understanding. For instance, constructing a model of the digestive system may appeal to visual learners, conducting experiments may engage kinesthetic learners, and group discussions may support auditory learners. When activities are integrated thoughtfully, they create inclusive learning environments where all students, regardless of their strengths or backgrounds, have opportunities to succeed (Patel, 2021).

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Furthermore, activity-based learning encourages formative assessment by enabling teachers to observe students' processes, reasoning, and misconceptions in real time. As students work through activities, teachers can provide immediate feedback, modify instructions, or introduce clarifications. This ongoing assessment contributes to improve conceptual learning and prevents the accumulation of misunderstandings that often arise in teacher-centered classrooms (Nair, 2018). The emphasis on feedback and reflective learning also cultivates metacognitive skills in students, helping them evaluate their own learning progress.

Given these benefits, the present review examines the range of activity-based teaching strategies used to enhance science concept learning among Grade IV students. It synthesizes empirical evidence, pedagogical theories, and classroom practices to provide a comprehensive understanding of how activity-based methods influence learning outcomes. By focusing on Grade IV learners, the review highlights the developmental appropriateness and effectiveness of hands-on, inquiry-driven, and experiential approaches at this critical stage of education. Additionally, the review identifies challenges in implementing activity-based learning, along with recommendations for improving teacher preparedness, resource utilization, and instructional design.

Activity-based teaching strategies hold considerable promise for fostering meaningful science learning at the Grade IV level. They transform the science classroom into an interactive, engaging, and learner-centered environment where students actively construct scientific knowledge. The review underscores that when students participate in hands-on activities, engage in group inquiry, and apply concepts through real-world exploration, they achieve deeper understanding, improved retention, and heightened motivation. As science education continues to evolve, activity-based learning remains a powerful pedagogical tool for nurturing scientifically literate and enthusiastic young learners.

ACTIVITY-BASED TEACHING STRATEGIES IN SCIENCE EDUCATION

Activity-based strategies reviewed in existing research include: -

1. Hands-on Experiments

Simple experiments using classroom materials help Grade IV students visualize scientific concepts. Studies show improved conceptual mastery when learners observe scientific processes directly (Nair, 2018).

Hands-on experiments play a crucial role in enhancing science concept learning among Grade IV students by allowing them to directly engage with materials, observe phenomena, and explore scientific principles through active participation. Unlike passive listening, hands-on activities enable learners to construct knowledge through concrete experiences that align with their developmental stage, where tactile and visual learning dominate cognitive growth (Piaget, 1973). For young learners, simple experiments such as observing evaporation, testing magnetism, or planting seeds make abstract concepts meaningful and memorable.

Research shows that students involved in hands-on science activities demonstrate significantly higher conceptual understanding, motivation, and retention compared to those taught through traditional lecture-based approaches (Sharma, 2019). These activities also encourage inquiry, critical thinking, and problem-solving, as students explore "why" and "how" scientific processes occur. According to Kolb's experiential learning theory, learning deepens when learners actively experiment and reflect on their observations, making hands-on experiments an essential pedagogical tool in primary science education (Kolb, 1984).

2. Model-Making and Demonstrations

Students construct models of the water cycle, plant parts, or solar system, which enhances spatial and conceptual understanding (Patel, 2021).

Model-making and demonstrations play a crucial role in strengthening science concept learning among Grade IV students by providing concrete and visual representations of abstract ideas. When students construct models such as the water cycle, plant parts, or simple machines they actively engage in manipulating materials, which promotes deeper cognitive processing and conceptual clarity (Patel, 2021). Demonstrations further support understanding by allowing learners to observe scientific phenomena that may be too complex or unsafe for direct experimentation, such as evaporation or magnetism. These methods align with constructivist principles, where knowledge is built through hands-on and observable experiences rather than passive listening (Bruner, 1961). Research indicates that model-making not only enhances retention but also corrects misconceptions by linking theory with tangible evidence (Sharma, 2019). As a

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result, these strategies significantly improve comprehension, visualization skills, and learner engagement in primary science classrooms.

GROUP ACTIVITIES AND COLLABORATIVE LEARNING

Working in small groups fosters peer learning and promotes discussion-based understanding. Collaborative science tasks significantly improve concept clarity (Singh & Mehta, 2020).

Group activities and collaborative learning play a crucial role in enhancing science concept learning among Grade IV students by promoting peer interaction, shared problem-solving, and active participation. When students work together on science tasks such as experiments, model-making, or inquiry-based projects they exchange ideas, clarify misunderstandings, and co-construct knowledge through meaningful dialogue (Vygotsky, 1978). Collaborative learning encourages students to articulate their thinking, which strengthens conceptual understanding and improves communication skills. Research shows that young learners engaged in group-based science activities demonstrate higher motivation, improved reasoning abilities, and better retention of concepts compared to those taught through individual or teacher-centered methods (Singh & Mehta, 2020). Additionally, group activities foster social skills such as cooperation, responsibility, and respect for diverse viewpoints, making them essential for holistic learning. Overall, collaborative learning provides a supportive environment where Grade IV students can explore scientific concepts more deeply and confidently.

INQUIRY-BASED LEARNING

Students ask questions, investigate solutions, and develop conclusions. This method strengthens scientific thinking and problem-solving abilities (Chi & Wylie, 2014).

Inquiry-based learning is a student-centered pedagogical approach that emphasizes exploration, questioning, and critical thinking, making it particularly effective in primary science education. In this method, learners actively investigate scientific phenomena, formulate questions, test ideas, and draw evidence-based conclusions, thereby constructing their own understanding rather than passively receiving information (Bruner, 1961). For Grade IV students, inquiry-based activities such as simple experiments, observations, and guided investigations promote curiosity and deepen conceptual understanding by connecting learning with real-world experiences. Research shows that IBL enhances retention, fosters higher-order thinking, and helps correct misconceptions by encouraging students to validate ideas through hands-on inquiry (Chi & Wylie, 2014). Moreover, inquiry-based learning aligns with constructivist principles, enabling students to build on prior knowledge through active engagement and reflection. Overall, IBL strengthens scientific reasoning and significantly improves learning outcomes in elementary science classrooms (Nair, 2018).

PROJECT-BASED SCIENCE LEARNING

Projects such as “Growing a Plant,” “Simple Machines,” or “Sources of Water” help integrate science concepts with real-world applications (Rao & Reddy, 2019).

Project-Based Science Learning is an instructional approach in which students explore scientific concepts through real-world projects, fostering deeper understanding and skill development. In Grade IV science education, PBSL enables students to investigate topics such as plant growth, water conservation, or simple machines by engaging in inquiry, planning, experimentation, and presentation. This hands-on process strengthens conceptual clarity as learners connect theoretical knowledge with practical experiences (Rao & Reddy, 2019).

PBSL promotes collaboration, problem-solving, and critical thinking, as students work in groups to design solutions, collect data, and analyze results. According to Kolb’s experiential learning theory, learning becomes more meaningful when students actively participate in structured tasks that require reflection and application (Kolb, 1984). Studies have shown that project-based learning enhances motivation, improves retention of scientific concepts, and encourages independent learning behaviors among primary students (Kumar & Kaur, 2020). Thus, PBSL serves as an effective strategy for enriching science learning at the elementary level.

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KEY ACTIVITY-BASED TEACHING STUDIES INVOLVING ~60 GRADE IV STUDENTS

Study	Sample Size	Teaching Method	Key Findings
Sharma (2019)	60 Grade IV students	Hands-on experiments	Students showed 32% improvement in concept test scores compared to lecture-based group.
Kumar & Kaur (2020)	58 Grade IV students	Group activities + models	Significant gain in conceptual clarity and interest in science.
Nair (2018)	60 primary-level students	Inquiry-based learning	Higher retention and ability to explain scientific processes.
Patel (2021)	62 Grade IV students	Model-making & demonstrations	Improved spatial understanding and reduced misconceptions.
Singh & Mehta (2020)	60 elementary students	Collaborative activities	Increased participation, teamwork, and concept mastery.
Rao & Reddy (2019)	60 Grade IV students	Project-based learning	Higher engagement and long-term retention compared to traditional teaching.

DISCUSSION

The collectively reviewed studies indicate that activity-based teaching significantly enhances science concept learning among Grade IV students. Evidence suggests:

1. Conceptual Understanding Improves

Activities support concrete learning, allowing children to observe and manipulate scientific objects. This bridges the gap between theory and practice, resulting in deeper conceptual grasp (Kolb, 1984; Nair, 2018).

2. Increased Engagement and Motivation

Activities generate curiosity and enthusiasm. Students participating in hands-on learning demonstrate sustained interest and reduced distractions (Sharma, 2019).

3. Better Retention of Concepts

Activity-based learning strengthens long-term memory. In inquiry-driven lessons, students recall scientific processes even after weeks (Chi & Wylie, 2014).

4. Development of Scientific Skills

Students demonstrate improved observation, classification, and inference-making skills. Collaborative activities also enhance communication and teamwork abilities.

5. Reduction of Misconceptions

Traditional teaching often leads to memorization without understanding. Activities correct misconceptions through evidence-based learning (Patel, 2021).

II. CONCLUSION

The review clearly indicates that activity-based teaching strategies play a vital role in enhancing science concept learning among Grade IV students. Across multiple studies involving approximately 60 learners, activity-based approaches consistently outperform traditional lecture-based methods. Hands-on experiments, models, group tasks, inquiry-based strategies, and project-based techniques significantly improve conceptual clarity, engagement, scientific skills, and retention.

Therefore, integrating activity-based methods into primary science education is essential for nurturing scientifically literate, curious, and motivated learners. Schools should equip teachers with necessary training, resources, and instructional autonomy to effectively implement these strategies in Grade IV science classrooms.

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