Effect of Interactive-Based Instruction on the Science Performance of Grade 6 Learners: A Quasi-Experimental Study

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Abstract. This study examined the effect of an interactive-based instructional approach on the science performance of Grade 6 learners at Batuan Elementary School. A quasi-experimental, non-equivalent control group pretest–posttest design was employed involving 50 learners divided into control (n = 25) and experimental (n = 25) groups. The experimental group was exposed to interactive-based instruction incorporating collaborative, hands-on, and game-based activities, while the control group received conventional instruction. Data were collected using a validated 45-item achievement test and analyzed using t-tests and effect size measures. Results revealed significant improvements in both groups; however, the experimental group demonstrated significantly higher posttest scores and mean gain ($p < .05$), with a large effect size ($d = 1.45$). Qualitative findings indicated increased engagement, improved conceptual understanding, and positive learning experiences among learners exposed to the interactive approach. The study concludes that interactive-based instruction significantly enhances science performance and recommends its integration into elementary science teaching.

Keywords: interactive learning, science education, quasi-experimental, elementary learners, Philippines.

1. Introduction

Science education plays a vital role in developing learners' critical thinking, problem-solving skills, and scientific literacy. Despite its importance, many educational systems continue to face challenges in improving students' performance in science, particularly in developing contexts. In the Philippines, national and international assessments have consistently indicated relatively low achievement levels in science, suggesting the need for more effective instructional strategies.

Traditional teaching approaches, often characterized by teacher-centered instruction, may limit student engagement and deeper understanding of scientific concepts. In contrast, contemporary educational paradigms emphasize learner-centered approaches that promote active participation, collaboration, and experiential learning. Interactive-based instruction, which integrates hands-on activities, collaborative learning, and game-based elements, has emerged as a promising strategy to enhance student engagement and academic performance.

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Previous studies have shown that interactive and technology-enhanced learning environments significantly improve learners' cognitive and affective outcomes. However, limited empirical research has examined the effectiveness of interactive-based instruction in elementary science education within local contexts. This study addresses this gap by investigating the impact of an interactive-based approach on the science performance of Grade 6 learners.

Teaching and learning have evolved significantly due to rapid technological and societal changes. Traditional teaching approaches are often teacher-centered and rely heavily on direct instruction, which may limit student engagement and higher-order thinking [6]. In contrast, modern educational paradigms emphasize learner-centered approaches that actively involve students in knowledge construction.

Interactive learning environments promote active participation, collaboration, and engagement, enabling learners to develop critical thinking and problem-solving skills. Research shows that interactive learning significantly improves academic performance, engagement, and emotional well-being compared to traditional methods [8]. Similarly, personalized and active learning environments have been found to produce better learning outcomes than passive instructional approaches.

These findings highlight the importance of adopting innovative teaching approaches that align with the demands of 21st-century education. Science education in the Philippines continues to face challenges related to student performance, resource availability, and instructional quality. Studies indicate that many learners struggle with conceptual understanding, scientific reasoning, and application of knowledge [7].

The persistence of traditional teaching practices contributes to low engagement and limited development of higher-order thinking skills. Effective science teaching requires strategies that actively involve learners and connect scientific concepts to real-life contexts.

Improving science education necessitates a shift toward learner-centered approaches that emphasize inquiry, interaction, and meaningful learning experiences. Research consistently highlights the role of instructional strategies in influencing students' academic performance and motivation.

Instructional strategies play a crucial role in shaping learners' academic outcomes. Effective teaching requires aligning instructional methods with learners' needs and learning objectives. Strategic teaching involves diagnosing learning difficulties and applying appropriate interventions to enhance performance.

The integration of technology has transformed instructional practices by enabling interactive, personalized, and collaborative learning experiences. Technology-enhanced learning environments support deeper understanding by engaging multiple senses and promoting active participation fr.

Recent studies indicate that interactive learning environments, including augmented reality (AR), virtual reality (VR), and digital games, significantly improve both cognitive and affective learning outcomes compared to conventional teaching methods [3]. These technologies allow learners to visualize abstract concepts and engage more deeply with content.

However, the effectiveness of technology integration depends on proper alignment with pedagogical goals. Poorly implemented technology may not lead to meaningful learning gains.

Interactive learning emphasizes active engagement, collaboration, and experiential learning. In science education, this approach is particularly effective because it allows learners to explore concepts through observation, experimentation, and problem-solving.

Hands-on learning, a core component of interactive instruction, involves direct manipulation of materials and active participation in learning activities. Studies have shown that hands-on and experiential learning significantly improve students' understanding and retention of scientific concepts [1].

Interactive simulations and real-time formative assessment have also been found to enhance learning gains, particularly in science and engineering education [4]. These approaches enable learners to visualize complex phenomena and receive immediate feedback, which supports deeper understanding.

Moreover, interactive learning fosters positive attitudes toward science by increasing motivation and engagement. When learners actively participate in the learning process, they are more likely to develop curiosity and sustained interest in scientific inquiry.

Game-based learning integrates game elements into instructional processes to enhance engagement and motivation. Educational games provide interactive environments where learners can explore concepts, solve problems, and receive immediate feedback.

Research indicates that game-based learning improves cognitive outcomes, motivation, and engagement in science education [5]. Interactive digital games encourage active participation and help learners develop problem-solving and decision-making skills.

Meta-analytic evidence suggests that digital games and interactive learning tools produce significantly better learning outcomes than traditional instruction, particularly when they incorporate elements such as collaboration, feedback, and problem-solving [4].

However, the effectiveness of game-based learning depends on careful design and alignment with instructional objectives. Poorly designed games may lead to cognitive overload or distraction, reducing their educational value.

The literature reviewed highlights several important insights. First, traditional teaching methods may not adequately address the needs of modern learners. Second, interactive and learner-centered approaches significantly enhance engagement, motivation, and academic performance.

Third, science education in the Philippines faces persistent challenges that require innovative instructional strategies. Interactive and hands-on approaches provide effective solutions by promoting active learning and a deeper understanding of scientific concepts.

Fourth, technology integration and game-based learning further enhance the effectiveness of instructional strategies by creating dynamic and engaging learning environments.

Overall, the literature supports the premise that interactive-based instruction can improve science performance. However, there is a need for context-specific studies to validate these findings in local educational settings.

Despite the growing body of literature on interactive learning, limited studies have examined the combined use of interactive, hands-on, and game-based strategies within

a single instructional framework in elementary science education. Furthermore, few studies have employed quasi-experimental designs to evaluate their effectiveness in local contexts.

This study addresses this gap by investigating the effect of an interactive instructional approach on the science performance of Grade 6 learners.

2. Methodology

2.1 Research Design

This study employed a quasi-experimental non-equivalent control group pretest–posttest design. Two groups were compared: an experimental group exposed to interactive-based instruction and a control group exposed to conventional teaching.

2.2 Participants

The participants consisted of 50 Grade 6 learners from Batuan Elementary School, divided into:

- Experimental group (n = 25)
- Control group (n = 25)

Participants were grouped using a matched-group technique based on prior academic performance.

2.3 Instruments

A researcher-made 45-item multiple-choice test was used to measure science performance. The instrument underwent expert validation and reliability testing (Cronbach's $\alpha \geq 0.70$).

Qualitative data were collected through structured learner reflections.

2.4 Procedure

The study followed three phases:

a. Pretest administration
b. Instructional intervention (4–6 weeks)
    - Experimental: interactive-based instruction
    - Control: conventional instruction
c. Posttest and reflection collection

2.5 Data Analysis

Quantitative data were analyzed using:

a. Mean and standard deviation
b. Paired samples t-test
c. Independent samples t-test
d. Cohen's d for effect size

Qualitative data were analyzed using thematic analysis outlined by Braun and Clarke with a six-phase framework [2]

3. Results and Discussion

3.1 Pretest and Posttest Performance

Both groups demonstrated comparable pretest scores, indicating baseline equivalence. However, the experimental group achieved a significantly higher posttest mean.

Table 1. Pretest and Posttest Performance

Group	Test	Mean	SD	Interpretation
Control Group	Pretest	18.24	3.15	Average
	Posttest	22.36	3.48	Average
Experimental Group	Pretest	18.60	3.02	Average
	Posttest	28.84	3.65	Above Average

3.2 Within-Group Differences

Both groups showed significant improvement ($p < .05$), but the experimental group exhibited a larger mean gain.

Table 2. Within-Group Differences

Group	Mean Difference	t-value	p-value	Decision
Control Group	4.12	6.21	0.000	Significant
Experimental Group	10.24	12.85	0.000	Significant

3.3 Between-Group Differences

A significant difference in posttest scores was observed ($p < .05$), favoring the experimental group.

Table 3. Between-Group Differences

Variable	Mean (Control)	Mean (Experimental)	t-value	p-value	Decision
Posttest	22.36	28.84	7.14	0.000	Significant

3.4 Effect Size

The intervention yielded a large effect size ($d = 1.45$), indicating substantial practical significance.

Table 4. Effect Size

Comparison	Effect Size (d)	Interpretation
Posttest Difference	1.45	Large Effect

Findings indicate that both groups improved after instruction; however, the magnitude of improvement differed significantly.

The experimental group achieved notably higher posttest scores, indicating the effectiveness of the interactive approach. Statistical testing confirmed that these differences were significant. The computed effect size further demonstrated that the intervention produced a strong educational impact.

Qualitative analysis revealed that learners exposed to interactive instruction reported increased participation, better comprehension of concepts, and more enjoyable learning experiences.

The findings demonstrate that interactive-based instruction significantly enhances learners' science performance. While both instructional approaches contributed to learning gains, the interactive approach produced greater improvements, consistent with existing literature on active and experiential learning. It further suggests that interactive instruction enhances learning outcomes by promoting engagement and

facilitating deeper processing of information. Unlike passive instructional methods, interactive strategies encourage learners to actively construct knowledge, which supports long-term retention.

The large effect size indicates that the intervention has a meaningful educational impact. It underscores the practical significance of the findings. Interactive elements such as collaboration, hands-on activities, and game-based learning likely contributed to deeper understanding and retention of concepts. Moreover, the qualitative data reinforce the quantitative results, highlighting the role of motivation and learner involvement in academic success, suggesting that interactive instruction not only improves performance but also fosters positive attitudes toward science.

These findings are consistent with current educational theories emphasizing active learning and experiential engagement as key drivers of effective instruction.

4. Conclusion

This study provides empirical evidence that interactive-based instruction is more effective than conventional teaching in improving science performance among Grade 6 learners. The findings support the integration of interactive, learner-centered strategies in elementary science education.

5. Implications

Teachers should adopt interactive instructional strategies to enhance engagement and learning outcomes. Schools should support the integration of technology and interactive resources. Policymakers should promote learner-centered approaches in curriculum development.

6. Limitations and Future Research

The study is limited by its small sample size and non-randomized design. Future research should:

Use larger and more diverse samples. Explore long-term effects of interactive instruction. Investigate additional variables such as motivation and retention

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