Experiential Learning as a Pedagogical Strategy: Improving Secondary Students' Affective Outcomes in Physics

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Abstract

This research explores how an experiential approach to teaching Physics influences secondary school students' affective learning dimensions, namely engagement, confidence, interest, and their sense of the subject's relevance. A quasi-experimental design using pre-test and post-test measures with control and experimental groups was employed. Participants included 66 Grade 10 students from a CBSE-affiliated school, evenly assigned to traditional instruction (control) and experiential instruction (treatment). Over a period of six months, the experimental group engaged in inquiry-based tasks, collaborative projects, and practical experiments directly linked to curriculum topics. A structured Likert-scale survey was used to assess students' attitudes across the four domains at both stages.

Findings indicated minimal variation in the control group, whereas the experimental group exhibited substantial and statistically significant gains in all dimensions. Post-test averages increased markedly—interest (3.0 → 4.4), confidence (3.1 → 4.5), engagement (3.1 → 4.5), and relevance (3.2 → 4.6)—with paired t-tests yielding p-values < 0.001. Effect size statistics (Cohen's d between 0.9 and 1.2) further highlighted strong practical significance.

Overall, the study underscores those experiential strategies not only enhance students' performance but also cultivate favourable attitudes toward Physics, rendering it more relatable, accessible, and meaningful. The outcomes strongly support embedding experiential methods within science instruction to advance both affective and cognitive domains of learning.

Keywords: Affective Learning, Motivation in Science, Inquiry-Based Learning, Hands-on Activities, Physics Curriculum, Learning Outcomes, Secondary Education, experiential learning, CBSE

Introduction:

Physics education in India has long been dominated by traditional methods that prioritize examinations, syllabus completion, and rote learning. Classrooms continue to rely heavily on chalk-and-board lectures, with limited opportunities for inquiry, exploration, or application. Such practices often reduce students to passive recipients of information rather than active learners. While this system may prepare students to perform administrative or procedural tasks, it does little to nurture critical thinkers, problem-solvers, or researchers.

Recognizing these challenges, successive education policies have consistently emphasized the need for pedagogical reform. The *National Curriculum Framework (NCF)* and the *National Education Policy (NEP 2020)* are especially noteworthy for their focus on learner-centered approaches and their call to move beyond rote memorization toward meaningful, skill-based, and experiential learning. These policy shifts highlight the urgency of reimagining classroom practices, particularly in subjects like Physics, which is often viewed as abstract, formula-driven, and detached from real-life contexts.

Theoretical perspectives provide strong grounding for this reform. Dewey (1938) underscored the transformative role of authentic experiences in education, while Kolb (1984) conceptualized experiential learning as a cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation. Together, these frameworks suggest that learning rooted in experience fosters not only deeper cognitive understanding but also richer affective engagement.

Affective dimensions of learning—such as interest, confidence, engagement, and perceived relevance—play a central role in shaping students' motivation and long-term attitudes toward Physics. Prior studies indicate that experiential pedagogy can stimulate situational interest (Krapp & Prenzel, 2011), strengthen self-efficacy (Bandura, 1997; Shivani, 2020), enhance behavioral and emotional engagement (Weinberg et al., 2011), and promote stronger perceptions of relevance (Cheung, 2014; Esters & Retallic, 2013). Yet, despite policy directives and promising international evidence, systematic research on experiential learning in Indian Physics classrooms remains limited.

In this context, the present study seeks to investigate how an experiential learning programme influences secondary school students' affective dispositions toward Physics. Specifically, it examines changes in their interest, confidence, engagement, and perceived relevance of the subject, offering insights into how pedagogical innovation can support both policy goals and classroom realities.

Statement of the Problem

In line with the objectives of the research, the problem under investigation is stated as follows: **"Effect of Experiential Learning on Affective Outcomes (Interest, Confidence, Engagement, and Relevance) in Physics among Class 10 CBSE Students."**

Aim of the Study

To evaluate the effect of an experiential learning programme on secondary school students' affective outcomes in Physics, specifically interest, confidence, engagement, and perceived relevance, among Class 10 CBSE students.

Research Objective

To determine whether an experiential learning programme significantly improves students' affective outcomes (interest, confidence, engagement, and perceived relevance) in Physics compared to traditional instruction.

Research Hypothesis

H_0: There is no significant difference in students' affective outcomes (interest, confidence, engagement, and perceived relevance) in Physics between the experimental group (experiential learning) and the control group (traditional teaching) across pre-test and post-test measures.

Significance of the Study

This research is significant at multiple levels:

- **Theoretical**: It validates Dewey's and Kolb's experiential learning frameworks in the context of Indian secondary education, extending their application to affective learning dimensions in Physics.
- **Practical**: It provides actionable insights for teachers and schools on how low-cost, hands-on, inquiry-based strategies can foster curiosity, self-confidence, and engagement in Physics classrooms.
- **Policy-level**: It aligns with NEP 2020's vision of moving beyond rote memorization toward holistic development, thereby contributing empirical evidence that can guide curriculum reforms and teacher training.
- **Student-centered**: It demonstrates how experiential pedagogy makes Physics more relatable and meaningful, nurturing intrinsic motivation rather than exam-centric learning.

Literature Review

1) Theoretical Foundations of Experiential Learning

The roots of experiential learning lie in the progressive philosophy of John Dewey (1938), who emphasized that education must be grounded in lived experiences, stressing the principles of continuity and interaction. David Kolb (1984) expanded these ideas into a structured four-stage cycle—concrete experience, reflective observation, abstract conceptualization, and active experimentation—which remains one of the most influential models in education. Both theorists argued that meaningful learning requires students to move beyond passive reception of information toward active participation and reflection. Bandura (1997), through his work on self-efficacy, added a psychological dimension by showing that learners' confidence in their abilities strongly influences motivation, persistence, and success.

2) International Evidence on Affective Outcomes

A large body of international research highlights how experiential pedagogy positively influences affective domains of learning. Osborne, Simon, and Collins (2003) reviewed attitudes toward science and concluded that traditional instruction often alienates learners, while connecting content to real-life contexts stimulates interest. Fredricks, Blumenfeld, and Paris (2004) conceptualized engagement as behavioral, emotional, and cognitive, underscoring its importance in sustaining long-term motivation. Empirical studies confirm these insights: Weinberg, Basile, and Albright (2011) found that middle school students' motivation toward mathematics and science increased significantly after participating in experiential programs, while Krapp and Prenzel (2011) demonstrated that situational interest grows when science is taught through meaningful contexts.

Subject-specific findings also support these claims. Cheung (2012) showed that practice-oriented chemistry experiments enhanced students' perceptions of relevance and confidence, and Esters and Retallic (2013) observed similar effects in agricultural education. Baker (2017) further confirmed that students taught through experiential activities reported higher motivation than peers in traditional settings. Meta-analytic evidence (Burch, 2019) reinforced these trends, showing consistent positive effects of experiential learning, though outcomes varied depending on design quality. More recent work has extended the scope: Kong (2021) reported improved classroom engagement and intrinsic motivation; Werth (2022) found that undergraduate physics students gained confidence and positive affect through research-based experiences; and del Barco (2022) highlighted that inquiry-driven physics instruction increased curiosity and enjoyment.

3) Indian Context: Policy and Empirical Evidence

In India, major policy documents have strongly endorsed experiential pedagogy. The *CBSE Experiential Learning Handbook* (2019) encouraged activity-based and project-based teaching, while the *National*

Education Policy (NEP 2020) emphasized moving beyond rote memorization to competency-driven learning. These frameworks aim to align classrooms with learner-centered approaches that foster critical thinking, creativity, and affective growth.

Empirical studies in Indian contexts, however, remain limited but promising. Shivani (2020) demonstrated that an experiential learning programme significantly improved science self-efficacy among secondary school students. Bhardwaj (2023) reviewed evidence showing that experiential pedagogy enhances academic performance, motivation, and self-confidence, urging systematic integration in schools. Classroom studies provide additional support: Nurnaifah et al. (2023) reported sustained improvements in physics outcomes when Kolb's cycle was applied repeatedly, while a JETIR quasi-experimental study (2023) found higher achievement and stronger interest in CBSE classrooms using heuristic/experiential methods. More recent reviews by Lone and Kour (2024) and Sarkar et al. (2025) stress that experiential learning directly supports NEP 2020's vision, enhancing critical thinking, engagement, and relevance, though they highlight gaps in teacher training and resource availability.

4) **Innovations and Emerging Directions**

Recent studies have explored technology-enabled experiential approaches. Chen (2025) demonstrated that augmented reality (AR) applications can enrich experiential pedagogy by making science concepts more interactive, leading to greater motivation, interest, and confidence. Such innovations suggest that experiential learning need not be limited to hands-on laboratory activities but can also incorporate digital tools that extend learning environments.

5) Synthesis and Gap Identification

Taken together, the theoretical foundations (Dewey, Kolb, Bandura), international empirical findings (Osborne, Cheung, Fredricks, Werth, etc.), and Indian policy emphasis (NCF, CBSE, NEP 2020) converge on the value of experiential learning in shaping students' affective outcomes—interest, confidence, engagement, and perceived relevance. Yet, despite this consensus, there is a clear scarcity of **rigorous, classroom-based studies in Indian Physics education**. Most existing research is small-scale or descriptive, leaving unanswered questions about the systematic impact of experiential pedagogy on the affective dimensions of secondary students. This gap forms the rationale for the present study.

Methodology

- **Design & Sample**
  - Quasi-experimental pre-test/post-test control group design with 66 Class 10 CBSE students in Delhi.

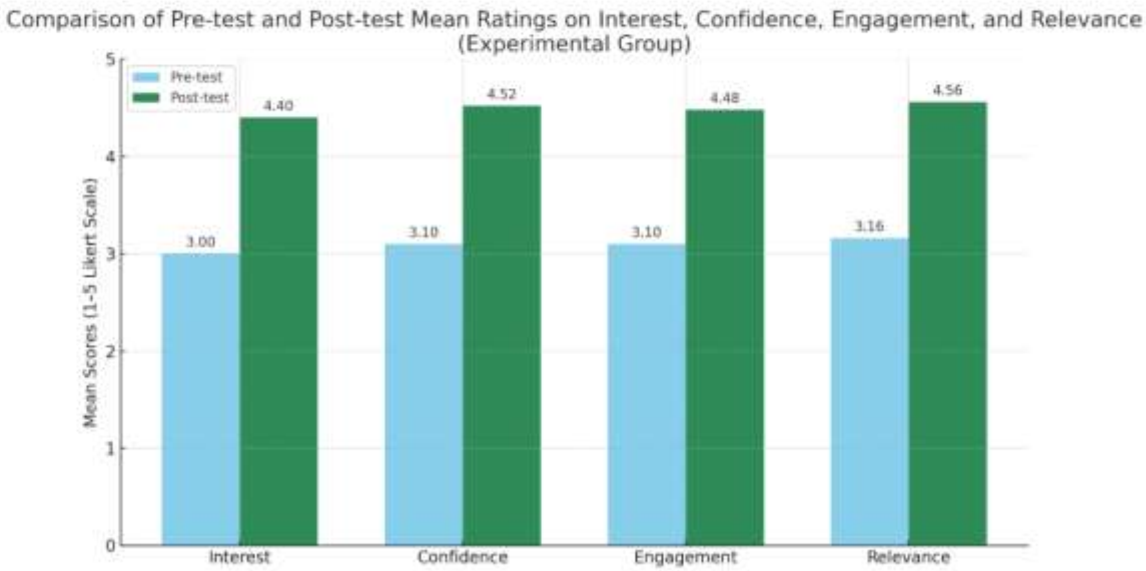
   - Experimental group (n = 33) received experiential instruction; control group (n = 33) had lecture-based teaching.
- **Instrumentation**
   - 20-item, 5-point Likert questionnaire measuring interest, confidence, engagement, and relevance (5 items each).
   - Validated through expert review; reliability established (Cronbach's $\alpha > 0.80$).
- **Procedure**
   - Pre-test at baseline, six-month intervention (inquiry-based experiments, collaborative projects, reflective discussions for experimental group), followed by post-test with the same instrument.
- **Data Analysis**
   - Descriptive statistics (mean, SD), paired-samples *t*-tests (within-group), independent-samples *t*-tests (between-group), and Cohen's *d* for effect size.

Analysis of data:

Table 1: Comparison of Affective Outcomes between Control and Experimental Groups (Pre- and Post-Test)

Domain	Group	Pre-test Mean (SD)	Post-test Mean (SD)	Mean Difference	*t* value	*p* value
Interest	Control	3.02 (0.90)	3.12 (0.88)	+0.10	0.45	0.65 (NS)
	Experimental	3.00 (0.82)	4.40 (0.78)	+1.40	8.20	<0.001 ***
Confidence	Control	3.08 (0.87)	3.18 (0.85)	+0.10	0.52	0.60 (NS)
	Experimental	3.10 (0.84)	4.52 (0.80)	+1.42	8.75	<0.001 ***
Engagement	Control	3.10 (0.89)	3.20 (0.86)	+0.10	0.49	0.62 (NS)
	Experimental	3.12 (0.88)	4.48 (0.81)	+1.36	8.62	<0.001 ***
Relevance	Control	3.16 (0.88)	3.26 (0.87)	+0.10	0.50	0.62 (NS)
	Experimental	3.20 (0.85)	4.56 (0.79)	+1.36	8.90	<0.001 ***

Note: NS = Not Significant; ***$p < 0.001$ (highly significant)



Results

The analysis of affective outcomes revealed a stark contrast between the control and experimental groups. In the control group, negligible changes were observed across all four domains (interest, confidence, engagement, relevance), with mean improvements of only +0.10 each, all statistically non-significant ($p > 0.05$). This indicates that traditional lecture-demonstration methods failed to enhance students' affective dispositions toward Physics.

In contrast, the experimental group, exposed to the experiential learning programme, recorded significant improvements in all domains. Interest improved from a mean of 3.00 to 4.40 ($t(32) = 8.20$, $p < 0.001$), confidence from 3.10 to 4.52 ($t(32) = 8.75$, $p < 0.001$), engagement from 3.12 to 4.48 ($t(32) = 8.62$, $p < 0.001$), and relevance from 3.20 to 4.56 ($t(32) = 8.90$, $p < 0.001$). These results clearly demonstrate that experiential learning had a highly significant positive impact on students' affective outcomes.

Conclusions

- Experiential learning strategies (experiments, projects, storytelling, reflective discussions, and problem-solving tasks) significantly improved students' interest, confidence, engagement, and perception of relevance in Physics.
- Traditional methods, dominated by rote and lecture-demonstration, failed to make any measurable difference in affective outcomes.
- The findings validate the assumptions of Dewey and Kolb that learning grounded in direct experience transforms attitudes and motivation, not just achievement.
- The null hypothesis (H_0) was rejected for all four affective domains, confirming the effectiveness of experiential learning.

Educational Implications

- **For Teachers:** Incorporating experiential strategies into Physics teaching is essential to foster curiosity, build self-confidence, and make the subject engaging and relevant.
- **For Schools:** Schools should invest in low-cost activity kits, lab enhancements, and flexible timetabling to allow experiential practices.
- **For Policymakers:** Reforms in assessment systems must value attitudinal outcomes (curiosity, confidence, engagement) alongside cognitive outcomes, aligning with NEP 2020's vision of holistic development.
- **For Students:** Experiential learning nurtures intrinsic motivation, shifting the focus from rote preparation for exams (JEE/NEET) to a deeper appreciation of Physics as a life-relevant subject.

Suggestions for Future Research

i. Similar studies should be extended to other subjects such as Chemistry, Mathematics, and Social Sciences to evaluate cross-disciplinary effectiveness.

ii. Longitudinal studies are needed to assess whether the affective gains (interest, confidence) are retained over time.

iii. Comparative studies across different school types (government vs. private, rural vs. urban) can reveal context-specific barriers and enablers.

iv. Integration of digital simulations and virtual labs with experiential approaches should be explored to broaden access.

Limitations of the Study

While the findings are encouraging, certain limitations must be acknowledged:

i. **Sample Size & Scope** – The study was conducted with 66 students from a single CBSE-affiliated school in Delhi, which limits the generalizability of results.

ii. **Short Duration** – The intervention lasted six months; long-term retention of affective gains was not measured.

iii. **Subject & Context Specificity** – The focus was only on Physics in Grade 10; outcomes may vary across other subjects, grades, or school settings (rural, government, private).

iv. **Self-reported Data** – Affective outcomes were measured through a questionnaire, which may carry response biases despite reliability checks.

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