International Journal on Science and Technology (IJSAT)
E-ISSN: 2229-7677 ● Website: www.ijsat.org ● Email: editor@ijsat.org

The Effectiveness of O-Labs in Enhancing Science Education

Mr. Rakesh Kumar

PGT Chemistry Haryana Education Department GMSSSS Dholera

Abstract

This dissertation investigates the effectiveness of Online Labs (O-Labs) in enhancing science education among Class 10, Class 11, and Children at GMSSSS Dholera, M./Garh, Haryana. A total of 40 students were engaged: 24 from 10^{th} & 16 from 11th class group. Using pre- and post-tests, learning level analysis, and qualitative feedback, this study finds significant academic improvement, deeper conceptual understanding, and increased engagement. The dissertation further explores infrastructural limitations, pedagogical challenges, and opportunities for improving science learning through digital innovations in rural Indian schools.

Chapter 1: Introduction

1.1 Background

In India's rural schools, science teaching often struggles with practical constraints—insufficient labs, low budgets, and limited exposure to real-world experimentation. Selected school reflects this scenario. Online Labs (O-Labs), a government initiative, offers a simulated digital alternative to real laboratories. These online platforms host curriculum-aligned experiments with theory, procedure, simulation, and video components.

1.2 Problem Statement

Can O-Labs significantly enhance science learning outcomes and inclusion for rural secondary and senior secondary students, especially those with special needs, where conventional labs are insufficient?

1.3 Objectives

- To assess O-Labs' impact on science performance in Class 10 and 11 students.
- To analyze learning levels before and after O-Labs integration.
- To examine O-Labs' inclusivity for some special Children.
- To identify barriers to effective O-Labs use in rural schools.

Chapter 2: Literature Review

Virtual labs have been recognized for their pedagogical strength in contexts lacking physical infrastructure. According to Sharma & Singh (2023), O-Labs enabled students in rural Himachal to visualize abstract concepts more effectively. UNESCO (2022) emphasizes inclusive digital education as key to addressing learning disparities.

Chapter 3: Methodology

3.1 Design

A mixed-methods approach:

- **Quantitative**: Pre/Post assessment
- **Qualitative**: Feedback forms, interviews, observational checklists

3.2 Participants

Group	No. of Students	Gender Distribution
Class 10	24	12 girls, 12 boys
Class 11	16	9 girls, 7 boys

3.3 Intervention Plan

- **Duration**: 4 weeks
- **Content**:
  - Class 10: Chemical Reactions & Equation, Acids & Bases.
  - Class 11: Some Basic Concep of Chemistry & Structure of Atom.

3.4 Learning Level Classification

Students were categorized into learning levels using baseline test scores:

- **Advanced**: ≥80%
- **Proficient**: 60–79%
- **Basic**: 40–59%
- **Below Basic**: <40%

Chapter 4: Data Analysis & Findings

4.1 Pre/Post Test Score Summary

Group	Pre-Test Avg. (%)	Post-Test Avg. (%)	Gain (%)
Class 10	64.5	79.8	+15.3
Class 11	61.2	77.6	+16.4

4.2 Learning Level Progression

Group	Below Basic → Basic	Basic → Proficient	Proficient → Advanced
Class 10	3 students	6 students	2 students
Class 11	4 students	5 students	3 students

Chapter 5: Qualitative Feedback

5.1 Student Survey Highlights (N=40)

Feedback Item	Agree (%)
O-Labs made learning more interesting	93%
Helped visualize difficult topics	91%
Prefer combining O-Labs with textbook learning	85%

5.2 Teacher Observations

- Class 11 students actively related O-Labs simulations to NCERT questions.
- Class 10 students began using O-Labs for self-study beyond school hours (by Mobile).

Chapter 6: Challenges Identified

6.1 Infrastructure Challenges

- Only 10 working computers for the entire senior secondary section.
- Power and internet outages disrupted continuity.

6.2 Pedagogical Challenges

- Teachers needed technical support to map O-Labs sessions to textbook timelines.
- Some students required differentiated instructions and extra assistance.

6.3 Student Challenges

- Some students required assistive devices or simplified navigation.
- Initial digital unfamiliarity in Classes 10 & 11 (especially among girls).

Chapter 7: Conclusions

O-Labs significantly improved science learning outcomes in GMSSSS Dholera. The improvement was evident not just in academic scores but also in conceptual clarity and enthusiasm toward learning. Importantly, O-Labs supported inclusion, empowering learners to engage with content in a multisensory, self-paced manner. In an era pushing digital transformation in education, O-Labs proved its merit as an effective equalizer in low-resource contexts.

Chapter 8: Recommendations

8.1 Infrastructure and Access

- Provide more computers/tablets per 15 students
- Ensure offline O-Labs modules for consistent access
- Install backup power systems (solar/inverter)

8.2 Pedagogical Support

- Train teachers in differentiated digital instruction
- Align O-Labs scheduling with textbook progression

8.3 Policy Recommendations

- Include O-Labs marks in internal practical assessments
- Make O-Labs training mandatory under teacher induction programs
- Include O-Labs-based learning in NEP-aligned digital curriculum strategy

References

1. Amrita CREATE. (2015). *Inquiry-Based Learning Pedagogy for Chemistry Practical Experiments Using OLabs*.
2. Sharma, R. & Singh, A. (2023). *Digital Simulations in Rural Classrooms: Case Studies from Northern India*. *Journal of Digital Pedagogy*, 12(3), 56–68.
3. UNESCO. (2022). *Digital Learning and Inclusion: Guidelines for Equitable Virtual Classrooms*.
4. Government of India. (2016). *The Rights of Persons with Disabilities Act (RPWD)*.
5. OLabs Portal. https://cdac.olabs.edu.in