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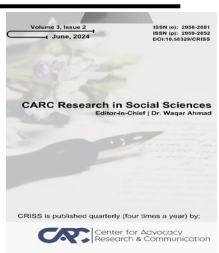

EVALUATING LABORATORY CONDITIONS FOR SCIENCE EDUCATION: A COMPARATIVE STUDY OF PUBLIC AND PRIVATE SECONDARY SCHOOLS IN DERA ISMAIL KHAN

Dr. Muhammad Asif Minhas*, Certified Teacher, Elementary and Secondary Education Department, Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan. Email: minhasmcs@gmail.com

Abstract: This research explores the condition of science laboratories in public and private secondary schools in Dera Ismail Khan, Pakistan. A well-maintained laboratory is vital for effective science instruction, as it provides students with hands-on experiences that reinforce theoretical knowledge. Using structured observation tools and qualitative feedback from teachers, this study compares the physical environment, cleanliness, ventilation, safety infrastructure, and usability of science laboratories. Findings indicate that private schools tend to maintain better facilities, while public schools often suffer from deteriorating infrastructure, lack of maintenance, and unsafe or outdated setups. The article concludes with recommendations for improving laboratory conditions to promote equitable science learning experiences across the district.

Keywords: Laboratory conditions, science education, public schools, private schools, secondary education, Dera Ismail Khan, infrastructure disparity

INTRODUCTION

Science laboratories are essential components of modern secondary education, especially in subjects like biology, chemistry, and physics, where direct observation and experimentation reinforce learning. Laboratories help develop scientific reasoning, procedural skills, and inquiry-based thinking among students. However, these educational goals cannot be achieved without appropriate lab infrastructure and environmental conditions.

In Pakistan, education is offered through public and private systems. Public schools are managed and funded by the government, while private schools are operated by individuals or organizations, often generating income through tuition fees. Due to financial and administrative differences, public and private schools vary significantly in terms of laboratory conditions and infrastructure quality. This study seeks to investigate these differences through a comparative analysis.

Statement of the Problem

Despite the critical role that science laboratories play in enhancing experiential learning and scientific understanding, many secondary schools in Pakistan—particularly in the public sector—struggle with poorly maintained, inadequately equipped, or entirely non-functional laboratory environments. In contrast, private schools often exhibit comparatively better infrastructure due to autonomous management and dedicated resources. This

uneven access to quality lab conditions creates a significant disparity in the learning experience of students from public and private institutions.

This study seeks to explore and compare the prevailing conditions of science laboratories in public and private secondary schools in Dera Ismail Khan, identifying the extent and nature of these disparities.

Contextual Background

The National Curriculum of Pakistan emphasizes the integration of theoretical and practical components in science education. Laboratories, therefore, are not supplementary but integral to curriculum implementation. A conducive lab environment includes:

- Adequate lighting and ventilation
- Clean workspaces
- Availability of gas, water, and electricity
- Functional furniture and fixtures
- Storage and labeling of chemicals and equipment
- Fire safety, first aid, and emergency procedures

Unfortunately, public school laboratories often fall short of these standards. A study by Saeed and Yousaf (2020) found that 65% of public sector schools in Khyber Pakhtunkhwa had incomplete or non-functional science labs. Meanwhile, private schools—particularly those charging moderate to high fees—show greater investment in science infrastructure.

This gap affects the delivery of practical science lessons and contributes to learning inequality. Students in under-resourced environments may never perform real experiments, undermining their understanding of basic scientific concepts.

METHODOLOGY

Design and Sample

This was a comparative descriptive study. A total of 20 secondary schools were selected for observation:

- 10 public secondary schools (government boys' and girls' schools)
- 10 private secondary schools (low- to mid-fee range)

Data Collection Tools

- A structured observation checklist was developed, covering the following categories:
- General lab structure and cleanliness
- Furniture and fixture condition
- Lighting, ventilation, and airflow
- Gas and water supply
- Electrical wiring and safety
- Presence of first aid kits and fire extinguishers
- Maintenance practices and repair history

Teachers and lab assistants were also asked informal questions regarding maintenance routines and usage patterns.

Data Analysis

Data were analyzed using frequency counts and comparative percentages. Visual inspections were documented with brief field notes. Schools were not identified by name to maintain anonymity.

FINDINGS AND DISCUSSION

Infrastructure and Space

Private Schools: 90% had purpose-built laboratories with appropriate workbenches, storage, and sufficient seating capacity.

Public Schools: Only 50% had dedicated labs. Others used general classrooms or outdated lab rooms lacking basic structure.

Cleanliness and Hygiene

Private schools regularly cleaned their labs, maintained floors, and replaced damaged equipment. Public schools suffered from poor cleanliness, cobwebs, rusted racks, and broken furniture. No cleaning staff were assigned specifically to science labs.

Lighting and Ventilation

80% of private schools had well-lit labs with natural and artificial lighting, ceiling fans, and cross-ventilation. Only 40% of public schools had functional fans or window shutters. Labs often felt congested and stuffy.

Water, Gas, and Electricity Supply

In private schools, all three utilities were reliably available. In public schools, many labs lacked running water. Gas connections were non-functional or absent. Electricity was often interrupted.

Safety Measures

Private: Most labs had working fire extinguishers, first aid kits, and safety signs.
Public: These items were often absent. None of the observed public labs had visible safety instructions or emergency exits.

Maintenance Practices

Private institutions conducted regular maintenance, supported by school management or parent-teacher associations. Public institutions lacked maintenance budgets. Repairs were delayed for years, and basic replacements were rare.

CONCLUSION

This study highlights a concerning disparity in the laboratory conditions of public and private secondary schools in Dera Ismail Khan. While private schools generally maintain safe, functional, and clean lab environments, public schools continue to struggle due to systemic neglect and funding limitations. These disparities not only affect the quality of practical science teaching but also reinforce broader educational inequalities. Improving laboratory infrastructure in public schools should be a policy priority.

RECOMMENDATIONS

1. Allocating separate funds for lab repairs and safety upgrades
2. Regular inspections by district education authorities
3. Collaboration with NGOs for infrastructure support
4. Mandatory training for science teachers in lab safety and maintenance
5. Ensuring all students have access to safe and stimulating learning environments is critical to advancing science literacy and preparing youth for future scientific careers.

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