11.	The effect of laboratory-based instruction and assessment on student attitudes toward the laboratory experience and achievement in chemistry at the high school level.	Orehowsky & Walter (1999)	Laboratory instruction improved both academic performance and student attitudes toward chemistry.
12.	An assessment of availability and utilization of laboratory facilities for teaching science at the secondary level.	Pareek (2023)	Only 1 of 21 schools had a functional lab; the lack of standalone labs, time slots, and trained teachers hindered effective science teaching and hands-on learning.
13.	A Study of Teaching of Science in Rural Primary Schools-Standards I to VII.	Patole (1967)	Highlighted the lack of labs and equipment in rural schools; emphasized the need for more practical work in science education.
14.	Developing an Instructional Strategy and Studying its Effectiveness for Comprehension in Science Among Class VII Students.	Prerana H. Shelat (2012)	Demonstrated that scaffolded lab exercises significantly improved comprehension and retention of scientific principles.
15.	Challenges in Science Lab Facilities and Safety in Institutions.	Rahman et al. (2019)	Highlighted that poorly equipped prep and storage rooms compromise safety and instructional efficiency; recommended infrastructure improvements.
16.	Survey of science laboratories in the western region.	Rajput et al. (1978)	Reported that 91.43% of labs lacked water, gas, or electricity; 10% had no labs at all. Teachers struggled due to lack of time, large class sizes, and absence of lab assistants.

17.	The extent of availability and usage of various laboratory equipment among physics students in Port-Harcourt, Nigeria.	Tamunoiyowuna, S. (2022)	Revealed low usage and availability of lab equipment among physics students in Port Harcourt, which hindered understanding of practical science concepts.
18.	The upshot of availability and utilization of science laboratory inputs on students' academic achievement in high school Biology, Chemistry, and Physics.	Tekalign (2016)	Found that most schools lacked basic lab infrastructure for physics, chemistry, and biology; only 16.67% were adequately equipped. Practical work was difficult to conduct due to a lack of resources.
19.	A Study of Chemistry Laboratory Facilities in Senior Secondary Schools.	Thakur (2015)	Revealed poor infrastructure in both private and government schools. Issues like high student-teacher ratios and lack of chemicals discouraged effective lab use.
20.	General science in the high schools.	Venkataraman (1976)	Equipment was insufficient; classes were overcrowded; teachers used blackboard lectures due to a lack of training in audiovisual methods.
21.	The Effectiveness of Using the Laboratory in Learning Science.	Wahidah et al. (2021)	Emphasized benefits such as enhanced observation, enthusiasm, and skill development through practical work.
22.	Factors affecting the academic achievement of learners in Physical Sciences in selected Limpopo rural secondary schools.	Zenda (2016)	Identified poor teaching resources, lack of motivation, high teacher workload, and overcrowded classes as key factors affecting performance in physical sciences.

Conclusion

The review of related literature highlights the vital role that science laboratories play in enhancing the quality of science education. Practical work through laboratory activities not only deepens conceptual understanding but also fosters skills such as observation, critical thinking, problem-solving, and scientific inquiry. It makes science more engaging and meaningful for students by connecting theoretical knowledge to real-life applications.

Across different educational settings, laboratory-based learning has been consistently associated with improved academic performance and increased student motivation. However, the literature also reveals recurring challenges in the implementation of effective laboratory practices. These include lack of laboratory infrastructure, inadequate supply of equipment and materials, insufficiently trained teachers and lab assistants, overcrowded classrooms, safety issues, and poor integration of practical work into the curriculum. Many schools also fail to allocate sufficient time for lab sessions, reducing the effectiveness of practical learning.

Despite the recognized importance of laboratory work in science education, there remains a significant gap between its theoretical value and actual classroom practice, especially in under-resourced or rural educational settings.

There were no recent data or research reports available regarding the availability and utilization of science laboratories in the Bhopal district. In light of these findings, this study is being conducted in secondary schools of Bhopal to assess the availability and utilization of science laboratories and the challenges faced by teachers and students in this specific context. This research is significant as it will provide localized insights that can inform policy, resource allocation, and teaching practices to improve science education in alignment with national educational objectives.

Chapter 3:

Research Methodology

3.1 Introduction

Research methodology is the backbone of any systematic investigation. It outlines the overall approach taken by the researcher to collect, analyze, and interpret data in a way that ensures accuracy, validity, and reliability. A well-planned methodology is essential for answering the research questions effectively and achieving the objectives of the study.

In the present study titled "A Study of Availability and Utilization of Science Laboratories for Teaching-Learning Science in Secondary Schools of Bhopal," the research methodology plays a pivotal role in systematically exploring the current status of science laboratories, their practical use in the teaching-learning process, the challenges encountered, and the perceptions of both teachers and students.

The methodology chapter explains how the study was conducted, including the strategies and tools used. It ensures that the research process is transparent, replicable, and grounded in scientific principles. It helps in:

- Structuring the research process logically and systematically.
- Ensuring objectivity and minimizing biases.
- Providing appropriate tools and techniques to gather accurate and relevant data.
- Justifying the selection of the sample, research design, and methods of analysis.

To ensure a comprehensive understanding, this chapter is organized into several key sections:

1. Research Design: Describes the overall plan and type of research used (e.g., descriptive survey method), along with its suitability for the present study.
2. Population and Sampling: Explains the target population and the sampling technique used to select participants, ensuring representation from both central and state government secondary schools in Bhopal.
3. Tools for Data Collection: Details the development and use of questionnaires for students and teachers, along with observation schedules, to gather qualitative and quantitative data.
4. Data Collection Procedure: Outlines the steps taken to administer the tools, obtain consent, and ensure ethical considerations like confidentiality and voluntary participation.