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**MANAGING SCIENCE LABORATORIES FOR THE EFFECTIVE  
TEACHING AND LEARNING IN PUBLIC SECONDARY SCHOOLS IN  
ANKPA, KOGI STATE, NIGERIA**

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Received: 02/02/2026

Accepted: 09/02/2026

Published: 16/02/2026

**ABSTRACT**

This research explores the structure and utilisation of science laboratories in public secondary schools in Ankpa, Kogi State, Nigeria, highlighting the significant issues in this locality. The empirical study on scientific laboratories highlights scientific laboratory challenges in Ankpa, such as insufficient science laboratories, lack of essential equipment, not enough trained hands to run the science laboratory services, and teachers with insufficient laboratory skills, and with all of these lead to a theoretical mode of teaching in the schools which means students are not often experiencing what they have been taught. New laboratories have been built during this period, but science learning in Ankpa is still lagging far behind the ideal or acceptable level. The research advocates a holistic reform that includes improved infrastructure, ongoing professional development to equip teachers with relevant knowledge, financial support, and laboratory safety. The study adds that for schools to address the science laboratory challenges, it is critical to introduce a few of the strategies, which may include staff members implementing inquiry-based teaching methods; leveraging Information and communication technology (ICT); improved ways of operating and managing laboratory environments, and using improvised materials, which are correctly implemented. The findings of this study identify attributes that warrant re-examination and call for improvements or enhancements to policies and strategies for learning science in Ankpa and other areas of Nigeria. Pursuing effective strategies will improve scientific literacy, promote student engagement, and contribute to technological development.

**Keywords:** Challenges, Effective teaching and learning, Managing, Public secondary schools, Strategies, Science laboratories

## 1.0 INTRODUCTION

Science education is essential for promoting scientific literacy and technological development (Okeke, 2021). In Nigeria, the management and use of science laboratories in public secondary schools as part of teaching and learning science subjects play a significant role in these subjects (Adeleke & Oloyede, 2020). Science laboratories are considered vital learning environments where students can apply theoretical knowledge to practical experience, thereby improving their understanding and engagement with science (Ogunyemi, 2019).

In Ankpa, Kogi State, the situation of science laboratories in public senior secondary schools raised concern. For example, Akor et al. (2025) reported that most public schools in Ankpa experience challenges with insufficient, inappropriate, or deficient science laboratory equipment, as well as with the availability of adequately trained science laboratory technicians. A current study, for example, also indicated that poor science laboratory conditions and inadequate teacher training can reduce the teaching of integrated science in junior secondary schools in Ankpa Local Government Area.

The significance of properly stocked and effectively operated science laboratories cannot be overemphasised. Studies by Wuyep (1994) have demonstrated that properly equipped, well-maintained laboratories are essential for improving students' practical skills and academic performance in science curricula. However, the experience in many public secondary schools in Ankpa suggests a gap between the ideal and the actual, as most schools cannot afford the resources to access or provide quality science lessons.

There have been attempts to improve the situation. For example, Hon. Rabi Alfa Momoh, from the Kogi State House of Assembly (Ankpa 2), initiated a project for science laboratory, library, and staff room building projects in Government Secondary School, Enabo, and Ojoku Community Secondary School (Kogi State Government, 2024).. While such projects are commendable in their own way, they address a minimal scope of infrastructural deficits, leaving many schools in the region without quality facilities to enhance academic performance (BudgIT Foundation, 2024).

Furthermore, the Federal Government of Nigeria has understood the criticality of upgrading science laboratories (Centre for Leadership and Sustainable Development, 2022). The Kogi State Medium-Term Sector Strategy (MTSS) for 2023–2025 acknowledges the need to upgrade science laboratories in all special science secondary schools (Kogi State Government, 2022). While this is a progressive approach, it remains to be seen how these policies will be implemented and what impact they will have on the teaching and learning of science.

Considering these factors, research will be conducted on science laboratory management in public secondary schools in Ankpa, Kogi State. The research will examine how well the science lab facilities are in terms of availability, adequacy, and utilisation of laboratory materials, in conjunction with the challenges faced by teachers and students. Research will serve as a means of capacity-building in procedures and policies to ensure the advancement of science education in the locality.

## **2.0 STATEMENT OF THE PROBLEM**

The availability and management of science laboratories are crucial to effective science teaching and learning in public secondary schools. In Ankpa, Kogi State, several challenges affect many public secondary schools, preventing science laboratories from being utilised to their full potential. Although everyone understands that learning in a laboratory context is important for scientific inquiry and for developing students' practical skills, many public secondary schools in Ankpa are reported to be suffering from inadequate and poorly maintained laboratory facilities, a shortage of instructional materials, and unqualified laboratory personnel.

If students are not engaged, authentic learning experiences through laboratory investigations are limited, and student academic performance in science subjects is poor. These conditions are further exacerbated by poor laboratory management and the lack of policies for laboratory management, equipment procurement, and facility management. The government and other stakeholders have made some efforts to address the problems in public secondary schools' science laboratories, including building new laboratories, providing resources for laboratory needs, and so on. However, the problems persist in many public secondary schools, and many students and teachers are still unable to utilise effectively all the important tools that science laboratories provide.

This research aims to investigate the severity of these issues by examining the impact of science laboratory management in public secondary schools in Ankpa on teaching effectiveness, student engagement, and academic performance. The outcomes will support practical recommendations for improving science laboratory management, thereby improving the quality of science education in the broader Ankpa context.

## **3.0 REVIEW OF RELATED LITERATURE**

Challenges Affecting the Management of Science Laboratories for Effective Teaching and Learning in Public Secondary Schools in Ankpa, Kogi State, Nigeria

Management in science laboratories is beneficial, as it emphasises the importance of practical skills and student involvement in science education. However, several obstacles prevent the effective use of science laboratory facilities in public secondary schools in Ankpa, Kogi State.

### **3.1 Inadequate Laboratory Facilities and Equipment**

One of the main challenges is the lack of adequate laboratory infrastructure and equipment, as most schools in the Ankpa area lack appropriate science labs and equipment to provide practical experience. Under these conditions, they have no option but to be taught in a theoretical way, which limits students' experiential learning (Ofeimu & Asemhe, 2022; Ghandi & Deghilipulu, 2025; Ogunjimi, 2025). As Adeyemi (2008) acknowledged, the lack of provision of science labs and equipment in many secondary schools is detrimental to the quality of science education.

### **3.2 Poor Maintenance and Utilisation of Laboratory Resources**

Despite the presence of science laboratories in Ankpa Local Government Area (LGA) in Kogi State, the issue of maintenance and use persists. Many schools do not have the right personnel to ensure that laboratory equipment remains in working order, which ultimately leads to breakdowns and long periods of inactivity. Teachers and laboratory staff lack proper training, which negatively affects the extent to which available resources are utilised, further impeding science instruction. Research has suggested that inadequate resources and a lack of training significantly reduce the level of utilisation of laboratory equipment in schools. For instance, Ofeimu and Asemhe (2022) observed that the adequacy of laboratory equipment and its utilisation were very low in the Edo North Senatorial District in Nigeria, and that the availability and utilisation of laboratory equipment would predict secondary school students' learning outcomes in Chemistry, Physics, and Biology. Similarly, Fatoba and Abidakun (2019) provided evidence from a study conducted in Ekiti State that the availability and utilisation of biology equipment and materials in senior secondary schools were moderate. They discussed the availability and utilisation of biology laboratory materials for practical work activities by school location.

### **3.3 Insufficient Teacher Training and Professional Development**

The competency of teachers who utilise science laboratories is linked to the effectiveness of these laboratories (Mbanefo & Eboka, 2022). In the Ankpa Local Government Area (LGA), for instance, many science teachers lack sufficient training in laboratory operations and effective practical pedagogy (Ofeimu & Asemhe, 2022). This was due to a lack of professional development, which led to ineffective practices and a lack of creativity in utilising the laboratories to support student learning. Research shows that developing teachers is important for improving the quality of science education by fostering a culture of ongoing professional development (Osiesi, 2024; Fataki et al., 2024). For example, Dung et al.'s (2024) study shows that ongoing professional development is fundamental to equipping STEM teachers with effective teaching practices to engage students and improve student learning.

### **3.4 Inadequate Funding and Resource Allocation**

Financial constraints are a significant hindrance to the creation and maintenance of science laboratories (Chukwu & Jongshwan, 2022). Schools in Ankpa face difficulties in obtaining funding to purchase laboratory equipment, chemicals, and other necessary materials (Rey & Liezi, 2024). Due to inadequate financial resources, some laboratories lack the necessary materials, hindering the quality of science education (Smith, 2020). Providing adequate materials and infrastructure necessary to support effective science teaching requires adequate funding.

### **3.5 Poor Infrastructure and Learning Environment**

The state of school buildings and laboratories has a significant impact on the learning experience. In Ankpa, many schools are in rundown condition, with poorly ventilated laboratories, insufficient lighting, and limited space. None of these factors will enable practical science activities, and they will contribute to pupils' waning interest and performance in science subjects (Moses & Umar, 2024). The National Policy on Education in Nigeria, as emphasised, must be provided with safer learning environments to positively impact learning outcomes and attainment (Federal Republic of Nigeria, 2013).

### **3.6 Lack of Laboratory Technicians and Support Staff**

Many schools lack qualified laboratory technicians, worsening difficulties in managing science laboratories. Teachers frequently have to take on additional responsibilities for laboratory upkeep and preparation, which distract them from their teaching (Rozina et al., 2025). The lack of support staff creates inefficiencies in laboratory operations and negatively affects the quality of science education (Wema et al., 2024).

### **3.7 Limited Access to Information and Communication Technology (ICT)**

The incorporation of ICT into science teaching and learning can promote meaningful learning. However, limited access to ICT (such as computers, internet connectivity, and digital learning tools) in Ankpa poses a barrier to the adoption of innovative teaching practices. Without adequate ICT infrastructure, teachers have limited opportunities for multimedia presentations and virtual simulations in science teaching and learning, hindering student exposure to a variety of teaching and learning modes (Molla & Seyoum, 2022; Planinc & Kolnik, 2016).

The challenges impacting the management of science laboratories in public secondary schools in Ankpa, Kogi State, are diverse and interrelated. These issues will need to be addressed holistically with proper funding, infrastructure, teacher development and training, and resources. Addressing these challenges will enable schools to create and maintain positive environments for practical science education, thereby increasing student engagement and achievement across all science courses.

## **4.0 STRATEGIES FOR MANAGING SCIENCE LABORATORIES FOR EFFECTIVE TEACHING AND LEARNING IN PUBLIC SECONDARY SCHOOLS IN ANKPA, KOGI STATE, NIGERIA**

Proper management of science laboratories is essential for improving the quality of science education in public secondary schools. Small-scale efforts to address the challenges of laboratory management in Ankpa, Kogi State, could enhance students' involvement and success in science subjects.

### **4.1 Implementation of Inquiry-Based Teaching Methods**

Inquiry-based teaching methods (IBTM), which include the Inquiry Laboratory Technique (ILT), have been shown to improve students' retention and understanding of scientific concepts. A study conducted in Gombe State (Manu et al., 2021) found that students taught using ILT performed better and retained their learning longer than those taught using lecture methods. IBTM encourages students to engage actively with their learning and develop critical thinking skills (Ogundare & Bashir, 2021).

### **4.2 Professional Development for Science Teachers**

Ongoing professional development is necessary for science teachers to use laboratory resources effectively (Smith, 2018). Studies suggest that participation in workshops, seminars, and conferences focused on exciting instructional approaches can influence teachers' use of laboratory spaces (Jones & Taylor, 2020). Professional development prepares teachers to acquire the skills and methods to manage laboratories effectively and to implement contemporary teaching styles (Brown, 2019).

### **4.3 Adequate Provision and Maintenance of Laboratory Resources**

A well-functioning laboratory with suitable facilities and proper maintenance is important for productive science education (Smith, 2017). Studies indicate that inadequate facilities and maintenance can negatively affect students' academic performance in science (Johnson & Lee, 2018). Scheduling maintenance and appropriate storage can extend equipment's lifespan and enhance safety in learning (Adams, 2020).

### **4.4 Integration of Information and Communication Technology (ICT)**

The incorporation of Information and Communication Technology in science education can enrich the teaching and learning experience. The use of digital tools and resources can present interactive simulations and virtual experiments to support traditional laboratory work. A study conducted in Ankpa Local Government Area has established that the use of ICT in integrated science instruction improves active engagement and understanding of science concepts among students (Eze & Akubugwo, 2017; Banda, 2021; Rosli & Ishak, 2024; Vwamse, 2024).

## 4.5 Collaborative Efforts Between Stakeholders

The collaboration of government agencies, school administration, and the community is crucial to the proper management of science laboratories. Through collaboration, better resource allocation, infrastructure development, and policy implementation can be achieved. For example, Hon. Rabi Alfa Momoh's efforts to build science laboratories and libraries in schools in the Ankpa Local Government Area demonstrate collaborative efforts.

These initiatives can significantly improve the management of science laboratories in public secondary schools in Ankpa, Kogi State. By adopting inquiry-based teaching strategies, investing in teachers' professional development, ensuring the availability and maintenance of laboratory supplies, integrating ICT, and collaborating with stakeholders, science education will improve, and student outcomes will follow.

## 5.0 EMPIRICAL STUDIES

Challenges Affecting the Management of Science Laboratories in Public Secondary Schools in Ankpa, Kogi State, Nigeria

Several empirical studies have identified and investigated factors obstructing the effective management of science laboratories in public secondary schools in Ankpa, Kogi State, Nigeria. Infrastructural deficiencies, insufficient resources, and environmental hazards are factors associated with the adverse effects on teaching and learning of science subjects.

### 5.1 Inadequate Laboratory Facilities and Equipment

Josiah (2022) conducted a study that found limited utilisation of laboratory equipment in public secondary schools in the Edo North Senatorial District of Nigeria. The findings showed that the essential laboratory equipment they needed, such as ammeters, voltmeters, and Bunsen burners, was either absent or unavailable. Even the little equipment that they do have was not accessible due to poor serviceability, and the state had not provided training. The situation mirrors that in Ankpa, where schools have suffered from limited and outdated laboratory facilities.

### 5.2 Environmental and Occupational Hazards

In a survey of the Ankpa Local Government Area, Attah (2022) examined environmental and occupational risks that pertained to science teaching. The findings revealed that science teachers and students faced multiple risks, including inhalation of hazardous chemicals and exposure to infectious agents during practical lessons, compounded by insufficiently safe practices. The risks associated with the inhalation of hazardous substances and exposure to infectious agents posed immediate threats to the health and safety of both science teachers and

science students and, at the same time, created an uncondusive learning environment, affecting the quality of science teaching.

### **5.3 Poor Maintenance and Utilisation of Laboratory Resources**

Ajemba et al. (2021) found that funding shortages, class size, and teacher training in science presented considerable barriers to science teaching in public secondary schools in Nigeria. These barriers were related to the general use of laboratory facilities and to a lack of available resources and expertise to use them effectively when needed.

### **5.4 Inadequate Teacher Training and Professional Development**

Pareek's (2019) research examined the availability and use of laboratory facilities in Nigerian schools and identified inadequate teacher training as a major barrier to the effective use of science laboratories. The researchers acknowledge that without appropriate training and professional development, teachers will be unable to manage laboratory activities effectively, thereby negatively impacting teaching and learning in school settings.

The empirical studies analysed present the wide-ranging challenges in the effective management of science laboratories in public secondary schools in Ankpa, Kogi State. To address these challenges, the study recommended a comprehensive approach that requires sufficient funding and development, improved infrastructure to support good laboratory practices, staff training and development, and the implementation of safety procedures for science learning.

## **6.0 STRATEGIES FOR MANAGING SCIENCE LABORATORIES FOR EFFECTIVE TEACHING AND LEARNING IN PUBLIC SECONDARY SCHOOLS IN ANKPA, KOGI STATE, NIGERIA**

The effective management of science laboratories is important for improving the quality of science education in public secondary schools. In Ankpa, Kogi State, several empirical studies have investigated and explored various solutions to enhance the management of science laboratories and improve teaching and learning.

### **6.1 Enhancing Teacher Competence through Professional Development**

In a study, Nwanya and Ugorji (2025) investigated the relationship between laboratory management skills and the effectiveness of Chemistry teachers in public secondary schools in Ihitte Uboma, Imo State. The researchers noted that there are statistically significant positive correlations between ordering skills, stocking/storage skills, and safety/maintenance skills and effectiveness. As a result of their findings, the training of Chemistry teachers should be routine to promote laboratory management skills that could prove helpful in similar circumstances in Ankpa.

## 6.2 Implementing Cooperative Instructional Strategies

An investigation conducted by Monica (2021) examined the influence of cooperative instructional strategies on students' commitment to physics in rural communities of Kogi State. The results showed that using cooperative learning strategies has positively impacted students' interest and engagement in science subjects. The authors suggested that applying cooperative strategies in science education laboratories could increase student engagement and learning.

## 6.3 Integrating Information and Communication Technology (ICT)

Olubunmi et al. (2024) investigated the factors influencing computer usage for teaching and learning in public secondary schools within the Ankpa Local Government Area. They found challenges, including a lack of skills, inadequate facilities, and insufficient power supply. They recommended ways to improve the use of ICT in science education, including professional development for teachers, the provision of hardware and internet access, and curriculum development.

## 6.4 Improving Laboratory Safety and Maintenance Practices

Achufusi and Ezeobi (2024) examined the extent to which safety and management practices are implemented in the resource biology laboratories of senior secondary schools in Enugu State. The study found that while a great extent of appropriateness was implemented in the design and fittings, the management practices were implemented to a low extent. The authors suggested that the government, individuals, science professional bodies, and non-governmental organisations should contribute to improving safety and management practices in the biological laboratory resources.

## 6.5 Utilising Improvised Teaching Materials

Joan conducted a study in 2021 on the effect of changing improvised teaching-learning materials on the academic performance of junior secondary students studying Basic Science in Enugu State, and found that students' performance was significantly better on the posttest, especially for those taught with improvised materials, compared to those taught with conventional materials. This finding points to improved experiences teaching and learning in classrooms and clinics, where improvised materials were used.

The research studies, case studies, and theoretical applications reviewed offer a range of approaches to improve science laboratory teaching and management in public secondary schools in Ankpa, Kogi State. They include increasing teacher capacity in laboratory safety, management, and maintenance through teacher development opportunities; implementing a cooperative instructional design methodology; using ICT; utilising improvised teaching materials; and improving overall lab site management practices. These applications will strengthen teaching and learning for all students in science.

## 7.0 CONCLUSION

Effective management of science laboratories is crucial in enhancing the quality of science education in public secondary schools, as it directly impacts students' practical skills and academic performance. This study assessed the status of science laboratories in Ankpa, Kogi State, and revealed serious challenges, including inadequate facilities, insufficient equipment, untrained staff, and inadequate teacher training. These issues are evidence of an over-reliance on theoretical delivery methods, resulting in students having little opportunity to develop practical skills in science laboratory experiments, which in turn contributes to the level of disengagement in science education thereafter.

Although measures have been taken to mitigate some challenges, like local government efforts and the construction of a new laboratory, there is still a need for significant improvements. The gap between the desired and actual state of science education in Ankpa underscores the need for sweeping changes to improve science education through enhanced infrastructure, robust continuous professional development for teachers, adequate funding, and improved worker safety at laboratory sites.

Adding strategies such as inquiry-based instruction, integrating ICT, improving laboratory storage, and using improvised materials in laboratory practice can improve laboratory management and student learning in science education. Adopting these strategies will enhance science education in Ankpa, making learning more interactive and practical for students.

This research serves as a starting point for developing new policies and interventions to address the challenges in science laboratory management. The research has implications for enhancing science education in Ankpa and similar contexts, promoting greater scientific literacy and technological advancement.

## RECOMMENDATIONS

The following suggestions are made based on the reviewed literature:

1. Local government, along with the state and federal governments, should focus on upgrading existing science laboratories to tackle the deficiencies of the current science laboratories, which include modern, working equipment, proper and functional storage, and laboratory space that is conducive to learning. Providing the necessary equipment is a priority; tools such as microscopes and Bunsen burners are a focus.
2. The schools should build a budget dedicated to properly stocking laboratory equipment, while allocating some consistent funding for purchasing new materials, chemicals, and digital resources so that there will always be funding for maintenance and improvement of laboratory resources. At both the state and local levels, there should be a reliable source of funding for labs to ensure lab maintenance.

3. The government should integrate workshops and seminars on current teaching methods and strategies, which include inquiry-based learning, as well as ICT-based teaching methods in the sciences, into the teacher training program, to facilitate ongoing professional learning programs for science teachers that develop their teaching and laboratory management skills. Training should also be made available to teachers on lab safety and the use of available resources to create a meaningful and engaging learning experience.

4. School management should ensure that schools have digital resources such as computers, projectors, and internet access to support virtual experiments and simulations in science. Once teachers are trained to use ICT tools, they can incorporate multimedia resources into lesson plans, creating a more interactive and accessible learning experience in science.

5. School leaders and education administrators need to promote inquiry-based approaches to teaching science as a way to increase student engagement and authentic learning opportunities. Inquiry-based learning, when executed effectively, can promote critical thinking and the development of problem-solving skills by actively engaging students in hands-on investigations, research projects, and experiments. Schools should employ strategies to encourage project-based research in laboratories or through group discussions, thereby helping students develop a deeper understanding of scientific concepts.

## **IMPLICATIONS OF THE STUDY**

### **1. Implications for Research**

The study's results underscore apparent deficiencies in their management and use within public secondary schools in Anka. For further implications, this study suggests that investigations into the influence of laboratory management on student learning outcomes in various locations in Nigeria should be continued. Future studies can also examine differences between regions with adequate labs and those with similar limitations to determine the potential impact over time on students' academic achievement. Importantly, the use of inquiry-based pedagogy and ICT in learning science is a positive direction for continued research to find the impact of these pedagogies on student engagement and practical skills.

### **2. Implications for Educational Practice**

The research highlights the importance of converting science labs from underused resources into responsive, active learning spaces. For teachers, the implications are clear: professional development around laboratory management and contemporary teaching practices is imperative. Teachers need training to effectively utilise existing materials, allowing them to improvise and create hands-on learning experiences for each student, even when resources are limited. Using inquiry measures alongside ICT in the curriculum is an essential step in improving science education overall and building creativity and critical thinking in students.

### 3. Implications for Policy

This research holds important implications for educational policy in Kogi State and beyond. Policymakers must acknowledge the pressing need for investment in infrastructure for science education, particularly science laboratories. The data indicate that policies intended to enhance educators' training, as well as to provide adequate resources and safety regulations, are important for improving the quality of science education. In addition, the policies should emphasise the integration of ICT into science teaching at the national level. Beyond this focus, policy initiatives should foster collaboration among stakeholders (e.g., government, local communities, and non-governmental organisations) to secure funding and resources, thereby reviving and maintaining science laboratories in public secondary schools.

### 4. Implications for Society

The research emphasises the broader societal benefits of enhanced science education in secondary schools. A properly managed science lab can significantly contribute to scientific literacy, a crucial foundation for innovation. By equipping students with the necessary skills and knowledge, society will eventually benefit from a generation better prepared to address challenges and opportunities in the 21st century. Additionally, improving science education in areas such as Ankpa can help reduce educational inequities and promote equitable access to quality education, thereby adding to social development.

### 5. Implications for Social Development

Addressing issues in science lab management could spark a chain reaction in social development. With students in Ankpa having improved science education, they will be better positioned to pursue careers in STEM. This has the potential to drive economic development at both local and national scales by establishing a new labour force that applies its training to local sectors of the economy, such as healthcare, technology, and innovation. In a social sense, this study is working towards a more equitable education system that will address gaps for all students, regardless of socio-economic status. Hence, supporting social equity and inclusion.

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