*IOSR Journal of Research & Method in Education (IOSR-JRME)*
*e-ISSN: 2320–7388, p- ISSN: 2320-737x Volume 12, Issue 3 Ser. I (May. – June. 2022), 13-19*
*www.iosrjournals.org*

# Factors Militating Against the Effective Use and Management of Science Laboratories in Secondary Schools in Plateau State

DR CHUKWU ANTHONIA CHILAGOROM
*CHEMISTRY DEPARTMENT*
*FEDERAL COLLEGE OF EDUCATION*
*PANKSHIN PLATEAU STATE*

JONGSHWAN RETSHWAR DANIEL
*CHEMISTRY DEPARTMENT*
*FEDERAL COLLEGE OF EDUCATION*
*PANKSHIN PLATEAU STATE*

***Abstract***
*The research was carried out to determine the factors affecting the use and management of science laboratories in Plateau State. Sixty secondary schools from the three geopolitical zones in Plateau State were chosen for the research. Five science teachers were chosen each representing chemistry, biology, physics and integrated science and one other science teacher from the sampled schools giving three hundred respondents as well as twenty technicians found in some of the sampled schools. Secondary School Science Laboratory Management Questionnaire (SSSLMQ) as well as check list were used to collect data. Data obtained were analysed using means and percentages and presented in tables. The finding of the study revealed that the major factor affecting the effective use and management of science laboratories in Plateau State is poor funding which manifests itself in lack of equipment, insufficient chemicals, absence of laboratory personnel, and shortage of water supply. It was recommended that Government should stop paying lip service to the need to develop science and do the needful as developing science in schools can never be achieved without the laboratory.*
***KEY WORDS:*** *FACTORS, MILITATING, EFFECTIVE, USE, MANAGEMENT, SCIENCE LABORATORIES, SECONDARY, SCHOOLS*

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Date of Submission: 01-05-2022 Date of Acceptance: 13-05-2022

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Children from every nation are subjected to one form of education or the other. This is due to the belief that the society can sustain itself; its norms and values through education or even bring into the society new desires and aspirations. Thus Samba and Eriba (2011) define education as the concept which refers to the process in which students are instructed, taught to acquire or learn specific knowledge or skills that can be applied to real life situations upon completion of learning. The education offered is expected to bring about all round development of the child.

Total education of the child cannot be achieved without science education. The place of science education is so acknowledged in Nigeria that she through her national policy in education offered a 60/40 admission rate into higher institutions of learning in Nigeria with science taken the higher rate (FGN, 2004). The oxford advance learner's dictionary 5$^{th}$ edition defined science as the study of structure and behaviour of the physical and natural world and society. To Ugwu (2002), science is an intellectual activity carried out by humans that is designed to discover information about the natural world in which we live. These definitions clearly shows that science involves a lot of activities. It is in this recognition that laboratories are established in institutions of learning. Government and science educators have been looking for ways of encouraging the students to become, motivated, interested and to excel in science. Hence the emphasis on the use of instructional materials and a well-equipped laboratory which is capable of giving the students adequate scientific experience with practical demonstration. Dali (2006) believes that science laboratory when used effectively for science activities helps to awaken and sustain students' interest in science.

Agbogun (2001) opines that laboratory activities provides students with opportunities to engage in processes of investigation and inquiry, problem solving ability as well as analytic and generalization ability. To Bybee (2002), science teaching without laboratory experience is not really science. Therefore the study of

science without carrying out experiment is just like swimming without water. Considering the importance of the laboratory then, the use and management of the laboratory becomes the concern of educators.

Organization and management are essential elements of any functional science laboratory. Laboratory organisation begins by providing the necessary service and equipment or material while management entails adequate and proper care of the provided facilities, services and equipment.

Efforts have been made by government to provide schools with laboratory and laboratory equipment. Is the effort adequate considering the poor level of skills acquired by secondary school students? The works of Bybee(2002), Arokoya(2003), and Oguniyi(2005) show that some years ago, there were obstacles to the effective use of the laboratory in teaching and learning of science in secondary schools. One wonders whether the situation has changed; and what will be the situation in Plateau State. What is the nature of the laboratories in our secondary schools now? Are they well equipped to offer the students the desired experiences? What about the management of the laboratories? Are the teachers or laboratory technologists well prepared to manage the laboratories? It is a well-known fact that laboratory work is an integral part of the final assessment of students at the secondary schools. Are the students offered adequate opportunity to make use of the laboratories? If the students are not well prepared for laboratory work, then it is most likely to affect their performance in science. Poor performance implies poor foundation in science. If the foundation of science is not well laid at the secondary school level, failure is inevitable even at the tertiary education level. It is one thing to have laboratory in schools and another to make effective use of them. Thus, this study set out to find out the factors militating against the effective use and management of science laboratories in Plateau State.

## I. Research Questions

The following questions were asked to guide the study

1 Do the secondary schools in Plateau State have science laboratories?
2 Who takes care of the laboratories in the secondary schools?
3 How often do the students carry out experiments in the laboratories?
4 Are the laboratories well equipped?
5 Are those taken care of the laboratories familiar with Laboratory management skills such as storage skills, safety skills, and manipulative skills?
6 What factors affect the effective use and management of science Laboratory?

## II. Methodology

Survey design was used for the research and it covered the entire state. Plateau State is divided into three geopolitical zones; Plateau South, Plateau Central and Plateau North. Twenty schools were selected from each geopolitical zone using systematic sampling. Five teachers were selected from each school. Effort was made to select a teacher each for biology, chemistry, physics and integrated science, and any other science teacher giving three hundred teachers as well as twenty laboratory technologists/technicians found in the schools.

The instrument used for data collection was Secondary School Science Laboratory Management Questionnaire (SSSLMC) and observation schedule (check list) for equipment in the laboratories. The instrument was subjected to face validity by three experts in the field of science education. They looked at the language of the items as well as their appropriateness vis- a-vis the research questions. Their inputs were used to come up with the final copy of the instrument.

The researchers went round the selected schools to give out the questionnaires and also check the laboratories using the check list. Some of the science teachers found in the schools were also used as research assistants

## III. Presentation And Discussion Of Results

**Table 1:** Presence of science laboratories in secondary schools in Plateau State.

| Laboratories | Number | Percentage |
|---|---|---|
| Available | 50 | 83.33 |
| Not available | 10 | 16.67 |

Table I shows that 83.3% of the schools have laboratories whereas 16.67% do not have laboratories

**Table 2:** Types of science laboratories in the schools

| Type | Frequency | Percentage |
|---|---|---|
| Single purpose | 10 | 16.67 |
| Dual purpose | 15 | 25 |
| Multipurpose | 25 | 41.7 |
| None | 10 | 16.67 |

Table 2 shows that 41.7% of the schools have multipurpose laboratories 25% have dual purpose 16.67% has either single purpose laboratory or no laboratory at all. 41.1 % of the laboratories are multipurpose.

**Table 3:** Care of the laboratories

| Option | Frequency | Percentage |
|---|---|---|
| Science teachers | 150 | 50.0 |
| Lab technologist/ technician | 100 | 33.33 |
| Lab attendants/assistant | 00 | 0.0 |
| None(no lab) | 50 | 16.67 |

The respondents indicated as shown in tables 3 that 50% of the schools are taken care of by science teachers, 33.33% by laboratory technologists/ technicians while 16.67% has no laboratories so nobody is in charge.

**Table 4:** Laboratory technologists /assistants in the schools

| Option | Frequency | Percentage |
|---|---|---|
| Nil | 40 | 66.67 |
| 1 | 15 | 25.00 |
| 2 | 3 | 5.00 |
| More than 2 | 2 | 3.33 |

Table 4 shows more than half the schools do not have laboratory personnel i.e 66.67% have no laboratory personnel, 25% has one laboratory personnel, 5.0 % has two personnel and 3.3% has more than one.

**Table 5:** Classes that carryout practical

| Option | Frequency | Percentage |
|---|---|---|
| SS1 | 40 | 13.33 |
| SS2 | 60 | 20.00 |
| SS3 | 200 | 66.67 |

Table 5 shows that practical is organized mainly for SS3 students most likely because it is examination class. Scientific skill is not meant for examination alone but for effective leaving in the environment.

**Table 6:** Availability and quantity of basic equipment /apparatus in the science laboratories

| Equipment/apparatus | Availability | | Quantity | |
|---|---|---|---|---|
| | Yes | No | Large above 10 | Small below 10 |
| Volumetric flask | 54 | 6 | 30 | 30 |
| Measuring Test tubes | 54 | 6 | 42 | 18 |
| Beakers | 54 | 6 | 42 | 18 |
| Pipette | 54 | 6 | 54 | 12 |
| Bunsen burner | 36 | 24 | 12 | 48 |
| Thermometer | 24 | 36 | 6 | 54 |
| Stirring rod | 30 | 30 | 18 | 42 |
| Spring scales | 36 | 24 | 12 | 48 |
| Tripod | 48 | 12 | 30 | 30 |
| Brushes for test tube | 48 | 12 | 36 | 24 |
| Tongs | 54 | 6 | 18 | 42 |
| Funnels | 54 | 6 | 36 | 24 |
| Burette | 54 | 6 | 28 | 12 |
| Conical flasks | 40 | 20 | 25 | 35 |
| Measuring cylinders | 40 | 20 | 25 | 35 |
| Crucibles | 20 | 40 | 10 | 50 |
| Tripod stand | 25 | 35 | 15 | 45 |
| Retort stand | 54 | 6 | 40 | 20 |
| Separating funnel | 10 | 50 | 5 | 55 |
| Wire gauze | 54 | 6 | 24 | 36 |
| Watch glass | 54 | 6 | 24 | 36 |
| Dropping pipette | 54 | 6 | 40 | 20 |
| Reagent bottles | 54 | 6 | 54 | 6 |
| Dropper | 36 | 24 | 18 | 42 |
| Magnifying glass | 36 | 24 | 30 | 30 |
| Voltmeter | 42 | 18 | 24 | 36 |
| Triple beam balance | 30 | 30 | 18 | 42 |
| Microscope | 30 | 30 | 12 | 48 |
| Magnet | 54 | 6 | 24 | 36 |
| Stop watch | 54 | 6 | 12 | 48 |
| Tape | 60 | 0 | 42 | 18 |
| Pulley | 54 | 6 | 18 | 42 |

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|---|---|---|---|---|
| Protractor | 60 | 0 | 24 | 36 |
| Dry cell battery accumulator | 54 | 6 | 18 | 42 |
| Pendulum bulb | 48 | 12 | 24 | 36 |
| Masses | 54 | 6 | 54 | 6 |
| Glass prism | 48 | 12 | 24 | 36 |
| Connecting wires | 54 | 6 | 18 | 42 |
| Resistance box | 48 | 12 | 18 | 42 |
| Knife edge | 54 | 6 | 24 | 36 |
| Meter rule | 60 | 0 | 42 | |
| Spiral spring | 48 | 12 | 18 | 42 |
| Thread | 54 | 6 | 48 | 12 |
| Optical pins | 54 | 6 | 18 | 42 |
| Bulbs | 54 | 6 | 48 | 12 |
| Filter paper | 54 | 6 | 54 | 6 |
| Animal skeletons | 60 | 0 | 12 | 48 |
| Dissection set | 42 | 18 | 12 | 48 |
| Petri dish | 54 | 6 | 18 | 48 |
| Litmus paper | 60 | 0 | 54 | 6 |
| Barometer | 36 | 24 | 0 | 60 |
| Pestle and mortar | 24 | 36 | 0 | 60 |
| Test tube rack | 54 | 6 | 24 | 36 |
| Spatula | 54 | 6 | 36 | 24 |
| Science charts | 60 | 0 | 30 | 30 |
| Wash bottle | 48 | 12 | 36 | 24 |
| Turning fork | 48 | 12 | 36 | |
| Acids | 40 | 20 | | |
| Bases | 40 | 20 | | |
| Chemicals (salts) | 35 | 25 | | |
| Distilled water | 20 | 40 | | |
| Indicators | 40 | 20 | | |

Table 6 shows the basic equipment/ apparatus found in the schools and some basic chemicals for chemistry practical.

**Table 7:** Science teachers/ laboratory personnel storage skills

| s/n | Items | Average |
|---|---|---|
| 1. | I keep equipment and chemicals together in the store | 2.86 |
| 2. | I can locate and replace materials in the laboratory when needed without any problem | 2.26 |
| 3. | When new supplies are made, I keep them arranged in the store | 3.08 |
| 4. | I keep all chemicals together and then all equipment together too | 2.86 |
| 5 | I arrange chemicals according to their types in the store eg acids and bases | 3.16 |
| 6. | I make sure that all chemicals in the store are labelled | 3.16 |
| 7 | I don't bother about labelling , I kept the items so I know which is which | 2.12 |
| 8. | There are no shelves so I keep all the items on the floor of the store | 2.34 |
| 9. | I arrange the items so that heavy ones are on the floor while lighter ones are on the shelve | 3.24 |
| 10. | I arrange the items considering their toxicity | 3.38 |
| 11. | I keep a catalogue of the items in the store for easy retrieval | 3.34 |

Grand average is 2.95.

The average of 2.95 which is greater than the criterion average of 2.5 shows that the respondents are familiar with storage skills

**Table 8:** Science teachers/ laboratory personnel safety skills

| s/no. | Items | average |
|---|---|---|
| 1. | I can quench fire in case of any fire outbreak in the laboratory | 3.24 |
| 2. | I open up windows any time practical is going on in the laboratory | 3.32 |
| 3. | I open exit doors during practical. | 3.34 |
| 4. | I have a well-equipped first aid box in the laboratory | 2.92 |
| 5. | I provide sand bucket in case of fire out break | 3.32 |
| 6. | I make sure spills are cleaned off immediately | 3.18 |
| 7. | I write safety rules boldly in the laboratory | 3.18 |
| 8. | I trust my class monitor to help me fix things in the laboratory in my absence | 2.84 |
| 9. | I am always the last to leave the laboratory after practical | 2.95 |
| 10. | I wear lab coat each time I work in the laboratory | 3.41 |
| 11. | I always put off switches and taps before leaving the laboratory | 3.15 |
| 12. | I make sure that students wear their lab coats while in the lab | 2.44 |

Grand average 3.1

The average of 3.1 which is greater than the criterion average of 2.5 shows that the respondents are familiar with safety skills.

**Table 9:** Science teachers / laboratory personnel manipulative skills

| Items | Average |
|---|---|
| I put the weighing balance in order whenever it is faulty. | 2.90 |
| I fix Bunsen burner when needed. | 2.88 |
| I can make the microscope function well. | 3.00 |
| I improvise for some the materials that are not in the laboratory. | 2.28 |
| Setting the lab for practical is a problem for me so I always call others to help me out. | 2.48 |
| I depend on others to help me fix the burette for practical. | 1.68 |
| I encourage students to handle equipment in the lab. | 3.21 |
| I don't allow students to handle equipment for fear of damaging it. | 3.22 |
| I fear pouring acid on my body so I don't like preparing reagent for acids. | 2.2 |
| Stock bottles are heavy and can easily slip from my hand; I call other people to help me pour out small quantity from the bottle into a beaker. | 3.5 |
| There is nothing hard about carrying stock bottles I only need to be careful. | 2.9 |
| I use the pipette with ease. | 3.5 |
| I rarely pipette without swallowing part of the reagent so I don't try it. | 2.5 |
| I easily carry out dissection for my students. | 2.6 |
| I can't disgrace myself; I just avoid any topic that needs dissection. | 2.4 |
| I fear electric shock So any practical that involves electricity is not for me. | 2.4 |
| I can easily create circuits for students' practical. | 2.8 |

Grand average 2.7

The grand average is greater than the criterion which is 2.5. This means that the laboratory personnel are familiar with manipulative skills.

**Table 10**. Factors affecting the effective use and management of science laboratory

| s/n | Items | Average | Decision |
|---|---|---|---|
| 1. | Small size of laboratory when compared with the number of students | 2.70 | Accepted |
| 2. | Short supply of necessary chemicals | 3.28 | Accepted |
| 3. | Lack of laboratory personnel | 2.92 | Accepted |
| 4. | Lack equipment in the laboratory | 3.16 | Accepted |
| 5. | Poor electricity supply | 2.36 | Rejected |
| 6. | Shortage of water supply | 2.88 | Accepted |
| 7. | Danger in the use of equipment | 2.40 | Rejected |
| 8. | Fear of handling chemicals like acids | 1.90 | Rejected |
| 9. | Lack of safety skills | 1.96 | Rejected |
| 10. | Lack of storage skills | 1.90 | Rejected |
| 11. | Lack of manipulative skills | 2.02 | Rejected |
| 12. | Inadequate experimental space | 3,5 | Accepted |
| 13. | Insufficient number of science teachers to conduct the practical | 3.0 | Accepted |
| 14 | Insufficient funding | 3.04 | Accepted |
| 15. | Poor school management | 2.70 | Accepted |
| 16. | Students negative attitudes towards practical | 3.0 | Accepted |
| 17. | Teachers poor attitude towards practical | 2.8 | Accepted |
| 18. | The belief that practical is only needed for SSCE examination | 3.0 | Accepted |

Table 7 shows that the major problems in effective use and management of the laboratory are insufficient equipment, short supply of necessary chemicals, poor funding, inadequate space for practical which is due to large class.

## IV. Discussion

The place of the laboratory in the effective teaching and learning of science can never be overemphasized. Once the laboratory is not properly used or managed, it has a lot of implications. The findings of this research leaves much to be desired. Table 1 shows that 16,67 % of the schools in the state do not have laboratories. The fact that 83.33% of the schools have laboratories is encouraging because it implies that practical will be conducted in the schools thereby developing scientific skills of the students thus making science learning lively and interesting. However, the schools without laboratories will lag behind. The students will lose out because laboratory is the most effective place to develop scientific skills and gain scientific knowledge (Arnold,2005).

This of course will not give the science teachers free hand to organise practical at will as each teacher must wait for his /her turn. They will compete for space to store materials and time for practical. Chukwu,

Mwanse and Duguryil (2009) recommend single purpose laboratories because everything patterning to the subject can be fixed in the laboratories. It also encourages the teacher to have extra lessons with his/her students. In schools where there are no laboratory personnel, the job of taking care of the laboratory will rest on the shoulders of the science teachers as shown in Table 3. The laboratory technologists are trained to take care of the laboratories. Their absence puts much pressure on the science teacher who has to conduct practical for students and also perform other functions in the college as a teacher.

The Table 6 shows that some schools do not have the equipment and in some where they are available, they are grossly inadequate. In some cases, the little equipment available are kept in the head teacher's office because there are no laboratories or stores to keep them. For science learning to be effective, there must be a well-equipped and functioning laboratory (Atura, 2012). Where this is lacking, the teacher will not only be frustrated but teach only theory while the students will resort to rote learning.

Tables 7, 8, and 9 show that those taking care of the laboratories are conversant with the management skills as the means in all skills investigated ie storage skills, safety skills and manipulative skills were all more than the criterion average. Thus the problem of using and managing the laboratory is not from knowledge of those managing the laboratories. However the average for manipulative skill is low and therefore calls for more training for the personnel in charge of the laboratories. Table 10 shows the factors that militate against effective use and management of the science laboratory. This include, short supply of necessary chemicals, lack of laboratory personnel, lack of equipment in the laboratory, students negative attitudes towards practical and teachers poor attitude towards practical. If the teachers and students do not have the right disposition, nothing will be achieved as far as practical activity is concerned. How can science education be enhanced if the laboratory is not well equipped even when the laboratory is available it is not managed by those prepared and trained to take care of it?

## V. Conclusion

Based on the findings of this research, it is clear that the laboratories in schools in Plateau State are poorly used and managed. Though a number of the schools have laboratories some schools do not have. Practical is conducted mainly for SS3 students because they are the students preparing for examination. This will not allow for the development of the scientific skills. The major factors affecting the effective use of the laboratory is centred on funding. This explains why there are insufficient equipment, chemicals and even laboratory personnel. It explains why the schools have multipurpose laboratory instead of single purpose laboratories. It explains why electricity and water are in short supply. Organization of practical classes for students in secondary schools is a must and should not be taken for granted. It should be for all students because nobody knows that child that will become another Bill Gates tomorrow or a great scientist like Faraday or Newton; so that few schools do not have laboratories is not acceptable at all.

## VI. Recommendation

1. Government at all levels should try to establish single science laboratories in the secondary schools to enable teachers plan laboratory activities for their students freely. Without interference from other teachers wishing to use the same laboratory.
2. Laboratory technicians/technologists should be employed to take care of the science laboratories in the secondary schools to avoid overlabouring the science teachers.
3. Efforts should be made by government, school management and even individuals to provide necessary chemicals, water and equipment to schools to enable students to carryout practical more often.
4. Government should stop paying lip service to the development of science and technology but show commitment by providing the needed infrastructure.
5. The laboratory personnel should be made to attend seminars and workshops to improve their management skills.

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DR CHUKWU ANTHONIA CHILAGOROM, et. al. "Factors Militating Against the Effective Use and Management of Science Laboratories in Secondary Schools in Plateau State." *IOSR Journal of Research & Method in Education (IOSR-JRME)*, 12(03), (2022): pp. 13-19.