

## Application of Laboratory Management Skills by Chemistry Teachers in Enugu State

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### Abstract

The study sought to find out how chemistry teachers apply laboratory management skills (LMS) in their teaching. The purpose of this study was to investigate the aspect of LMS which the chemistry teachers applied most in their teaching of chemistry and the extent of the application. Two research questions guided the study. The design is survey and the instrument used was a questionnaire. The respondents were one hundred and seventeen (117) chemistry teachers. The data collected were analyzed using mean score. The findings revealed that chemistry teachers applied ordering skills, stocking and storing skills. It was also revealed that chemistry teachers do not apply safety and maintenance skills. Among the recommendations was that chemistry teachers should be involved in routine retraining, workshops, and seminars in order to acquire the skills and also to keep them abreast with the importance of LMS in effective teaching and learning of chemistry.

**Key words:** Application, Laboratory, laboratory management skill, Chemistry and Teachers.

### Introduction

The development of science and technology requires a steady flux of resources and effective use of such resources. These resources are found in the laboratories. Bajah (1990) defined science laboratory as anywhere science can be taught or learnt. Laboratory is also a place where experiments in science are carried out. These experiments involve chemicals, specimens, materials and equipment. Amongst the secondary school core science subjects, chemistry is occupying a central position because it is a prerequisite for the study of valuable professional courses like medicine, nursing, engineering, pharmacy, laboratory technology, radiography, medical rehabilitation to mention but a few. This may be the reason why Urevbu (1990) stated that laboratory is the most distinctive feature of chemistry instruction and that it occupies a central position in sciences teaching. Science laboratory is characterized by practical approach in imparting knowledge to students and some education theorists like John Dewey formulated some theories that advocate the activity method of impacting knowledge to learners. John Dewey (1859-1953) was a philosopher and educator. His theory emphasized learning by doing which is an activity method. Some implications of Dewey's theories to science education are that the following: science teaching and learning must be built on the values of the society and on skills of the learner. Problem solving method should be used to teach the learner so that science teaching and learning should involve hands-on-activities, and experiments so as to give the learner the opportunity to manipulate and handle scientific equipment. Dewey's philosophy of work is also centred on training and acquisition of certain skills. In chemistry, experiments are drawn from Dewey's theory and learners are given opportunity to manipulate materials, chemicals and equipment. Gagne (1965) developed the theory of learning. To Gagne (1965) the highest level of learning is problem solving. Gagne's theory of learning hierarchy stated that learning of skill depends on the mastery of prerequisite concepts or skills. That is learning of skills should be from known to unknown. Gagne's theory is relevant to chemistry teaching especially in acquisition of practical skills.

Proper management of student's prerequisite skills in the laboratory will lead to acquisition of a higher skill or easier understanding of the required skills. Management pattern of practical work in chemistry laboratory can ensure sequentially move of basic practical skills to fundamental science skills needed in future career. Management according to Olaiton, Nwachukwu, Igbo, Onyemachi and Ekong (1999) is the process of planning, organizing, directing, implementing, and evaluating input resources for the purpose of producing output in the form of goods and services. Paul (2008) said that effective laboratory management is a learned skill which involves regular meetings and delegating responsibility. Management of science laboratory therefore means the running and controlling of materials and human resources. These are divided into two: (a) material resource management and (b) human resource management. Material resource management involves procuring, stocking, storing of materials, arrangement and maintenance of materials and equipment in the laboratory. Human resource management involves directing, planning and delegating duties to laboratory workers.

Human resources include the following: Qualified chemistry teacher. He/she is a teacher with the Nigerian Certificate in Education (NCE) or university graduate in the chemistry. Laboratory technician *are those* with Higher National Diploma (HND) or Ordinary National Diploma (OND). They also have responsibilities in the

organization and management of the laboratory and the also supervise other staff. Laboratory assistant are with senior school certificate or equivalent. They help teachers or technicians in preparations and carrying out of experiments. In schools where the technician is absent, the teacher can train them in preparing solutions, collection of specimens, purchasing of materials and storage of materials. Laboratory attendants are with first school leaving certificate. They clean the laboratory. Other human resources include resources persons from the locality and organizations being invited by the teacher.

Effective teaching and learning of chemistry at all levels demand many of the above mentioned laboratory resources. These resources are indispensable if indebt understanding of the subject will ever be achieved because they are utilized to make difficult and abstract concepts in chemistry real, remove misconceptions, ignite, increase and sustain students' interest and also help to consolidate conceptual understanding of things taught in theory lessons (Mbajorgu and Reid 2004; and Ezeano 2008). Despite the importance of laboratory resources, they are not adequately available in many secondary school laboratories. This may be due to huge sum of money required to provide them (Aniodo, 2008). Maintaining and repairing the productive resource materials or laboratory equipment and chemicals in the chemistry laboratory will help to reduce the cost of teaching and learning the subject. Chemistry teachers while in training are exposed to lots of laboratory management skills (LMS).

Laboratory management skills they are exposed to include ordering skills, stocking and storage skills and safety and maintenance skills. Dan Rhoads in Careers laboratory survival from the Bitesize Bio Channel (2008) indicated that LMS requires navigating tenure, hiring, and managing laboratory members, teaching and mentoring project management and collaborations. In University of Maryland, the University College Laboratory Management Degree Planning Workshop includes these as the LMS for the programme:

1. Create a healthy, safe, and productive work place by effectively and appropriating hiring, training, supporting and evaluating laboratory personnel.
2. Monitor and maintain laboratory-related documentation, equipment, and supplies, necessary for conducting efficient, safe, cost-effective and hygienic laboratory operations.
3. Manage (plan, organize, and direct) the daily work activities of a laboratory setting by working independently and as a member of a team, meeting job expectations, and adhering to organizational policies and goals.
4. Communicate thoughts orally and writing in a clear, well-organized manner that effectively persuades, informs and clarifies ideas, informative, and laboratory techniques/procedures to staff, scientific community and the public.
5. Practice ethical standards of integrity, honesty, fairness as a laboratory manager and professional.
6. Manage scientific and laboratory practices and procedures by complying with and adhering to national, state, and local standards, policies, practicals and regulations.

The LMS help chemistry teachers to be resourceful and increase their potentiality and creativity in chemistry education. It is chemistry teachers' ability to apply LMS that motivate them to improvise in absence of needed laboratory materials (Ezeano, 2001). LMS when effectively applied reduce accidents and damages and consequently reduce cost of laboratory material resources. LMS require the managerial abilities of chemistry teachers and laboratory assistant who help teachers in bringing out materials, washing and packing them after practical lessons.

LMS when duly applied can make both teachers and students to be more activity oriented and it can foster effective science teaching and learning and achievement. With all the benefits accruable by the application of LMS, there is need to ascertain the extent of application of LMS by chemistry teachers in the teaching and learning of chemistry.

### **1.1 Statement of the problem**

Chemistry laboratory equipment and chemicals are indispensable for effective teaching and learning of chemistry. But they are rarely adequately available due to their high costs. As a result many chemistry teachers could not conduct practical chemistry classes as and when due. Instead they wait until the period of external examinations is at hand. The conscientious and resourceful chemistry teachers resort to demonstration, even though it cannot replace the experience students have when they perform the experiment themselves (Ezeano, 2008). During chemistry practical lessons, chemistry teachers with the help of laboratory assistants prepare reagents and equipment needed for practical lessons, and also clean washes and packs them after the practical lessons.

The chemistry teacher requires laboratory management skills to be able to do his/her work effectively. The laboratory assistant who should be helping the chemistry teacher in laboratory management are lacking in many secondary school laboratories, leaving the work of teaching and laboratory management for the teacher alone. The chemicals and equipment when not properly managed may be wasted and harmful. Therefore, there is the need to ascertain the laboratory management skills (LMS) applied by chemistry teachers.

### **1.2 Purpose of the study**

The purpose of this study is to: (1) investigate the aspect of LMS which the chemistry teachers applied most, (2) find out the extent chemistry teachers apply LMS in the teaching and learning of chemistry.

### **1.3 Research Questions**

1. Which aspect of LMS do chemistry teacher applied most?
2. To what extent do chemistry teachers apply LMS in the teaching and learning of chemistry?

### **2. Methodology**

The design for this study is survey. The population for the study was 117 chemistry teachers in Enugu Education Zone of Enugu State. Simple random sampling was used to pick Enugu Education Zone from four education Zones that make up Enugu State. There was no sampling because the population was sizeable for the study. The instrument was a 33 items questionnaires on chemistry teachers' application of laboratory and management skills (LMS).

The instrument was on a five point rating scale with numerical values of very large extent (VLE (5), large extent (LM (4), moderate extent (ME (3), small extent (SM (2) and very small extent (VSE (1). The instrument was validated by experts in chemistry education and measurement and evaluation. The valuator's scrutiny, corrections and modifications were employed to prepare the final draft of the questionnaire. The five point responses with the assigned values of 5,4,3,2 and 1 respectively gave the average or mean of 3.00. Any mean score equal to and above 3:00 is accepted and any mean score below 3.00 is rejected. The questionnaire was distributed to the chemistry teachers. There was 100% return and the data gathered were analyzed using simple mean.

### **3. Results**

In line with research questions which guided the study, the results of the data analysis were presented in the table below

**Table 1: Mean scores of chemistry teachers on the LMS applied and the extent to which they applied them.**

S/No	Items on LMS employed by chemistry teachers	Mean (X)	Decision
<b>A,</b>	<b>Ordering skills</b>		
1.	Chemistry teachers; ordered for needed and relevant laboratory materials.	3.3	A
2.	Obtain quotations for items from more than one laboratory equipment suppliers	3.1	A
3.	Ensure priority placement on items that are ordered	3.3	A
4.	Ensure that the needed chemicals and equipment ordered for are supplied	3.5	A
5.	Arrange with knowledgeable laboratory equipment suppliers	3.2	A
6.	Check for and reject fake laboratory equipment and chemicals	4.3	A
7.	Compare cost of materials to their qualities	3.2	A
	<b>GRAND MEAN</b>	<b>3.4</b>	<b>A</b>
<b>B</b>	<b>Stocking/Storage Skills</b>		
8.	Labeling reagents boldly	3.5	A
9.	Separating chemicals that can react with each other	3.9	A
10.	Provide and use stock record book(s)	3.1	A
11	Considering production and expiring dates of chemicals	3.7	A
12.	Storing chemicals that are susceptible to photolysis in dark coloured bottles	3.2	A
13.	Preventing glass ware breakage by not storing them in nest pattern	3.2	A
14.	Record damages and breakages properly	3.1	A
15.	Properly disposing of broken glassware	4.2	A
16.	Careful recording and stocking of used-up chemicals	3.1	A
	<b>GRAND MEAN</b>	<b>3.4</b>	<b>A</b>
<b>C</b>	<b>Safety and Maintenance Skills</b>		
17.	Isolating radioactive, toxic flammable and carcinogenic chemicals	3.4	A
18.	Using warning symbols or signs where and when necessary	3.7	A
19.	Ensuring careful disposal of laboratory wastes (used chemicals)	3.2	A
20.	Making laboratory store assessable to only chemistry teachers and laboratory assistant	2.9	R
21.	Ensuring that drainages are functional	2.6	R
22.	Inspect apparatus, equipment and electrical appliances before allowing students to use them.	2.1	R
23.	Ensuring that used laboratory equipment are washed and packed	3.9	A
24.	Preventing and amending leakages of water and gas	2.9	R
25.	Repair equipment with minor problems like leaking burette, blocked pipette etc.	2.2	R
26.	Encouraging students to stand up during practical	2.0	R
27.	Ability to take care of students who may swallow base, spill acid on their bodies and floor	2.6	R
28.	Ensure that students wear lab coats and use their napkins	2.0	R
29.	Using fume cub board were necessary and available	1.5	R
30.	Reduce pilferage by not allowing students to enter the laboratory with their bags	3.8	A
31.	Ensuring that food is not eaten in the laboratory especially during practicals	3.1	A
32.	Ensuring that students do not play in the laboratory	3.0	A
33.	Making sure that students wash their hands after every practical before leaving	3.8	A
	<b>GRAND MEAN</b>	<b>2.6</b>	<b>R</b>
	<b>OVERALL GRAND MEAN</b>	<b>3.1</b>	<b>A</b>

From Table 1, it is evident that chemistry teachers rarely apply safety and maintenance skills (grand mean 2.6). The grand mean for safety and maintenance skills is below the cut -off point of 3.0. For instance, they did not ensure that students wear lab-coats and use their napkins during chemistry practical lessons (2.0), they did not repair equipment with minor problems like leaking burette, blocked pipette etc(2.2), they did not inspect apparatus, equipment and electrical appliances before allowing students to use them (2.1).

On the other hand, they applied the ordering skills (grand mean 3.4) and stocking, and storage skills (grand mean 3.4) most. They check and reject fake laboratory equipment and chemicals (4.4); they properly dispose of broken glassware (4.2); they separate chemicals that can react with each other (3.9) and considered production and expiring dates (3.7). In fact all the items under ordering and stocking/storage skills are above the cut-off point of 3.0, proving that chemistry teachers applied them to a reasonable extent.

### 3.1 Discussion of findings

The finding of this study revealed that chemistry teachers applied LMS, ordering and stocking and storage skills (3.4). The finding relates to that of Akubue and Eze (2007) who discovered the chemistry teachers utilized LMS to appreciable extent.

This study in addition, unveiled the fact that chemistry teacher did not apply safety and maintenance skills and this agreed with the finding of Akubue and Eze (2007) that discovered that teachers are not sufficiently skilled in the area of safety and maintenance of equipment and materials. This finding creates worry in the heart of reasonable and patriotic Scientists who have actually discovered that chemistry laboratories are ill equipped and requires the skills of resourceful teachers to safe and maintain little available laboratory equipment and chemicals.

The chemistry teachers' lack of skills of safety and maintenance, as discovered in this study, is also in line with the view of Idah (2004) who discovered that secondary school teachers lack safety awareness. This lack of skills for safety should be tackled with urgency by exposing the teachers to workshops, seminars and retraining them to instill into them the need for safety and maintenance in chemistry laboratory. This is necessary because according to Nwabueze (2002), ones chemicals and equipment are provided, the onus of storage and maintenance rest squarely on the shoulder of the science teachers. The exposure and retraining will make the science teachers to stand up to their responsibilities and avoid delay that may hinder science and technological advancement which the country has been yearning for.

## 4. Conclusion

The study which considered chemistry teachers' application of laboratory management skills (LMS) revealed that chemistry teachers applied the ordering and stocking and storage skills to high extent but they did not apply safety and maintenance skills. Despite the importance of LMS in the teaching and learning of practical chemistry, some aspects of LMS were not applied by chemistry teachers. This then revealed that there is a gap that require urgent filling in the teaching and learning of chemistry.

### 4.1 Recommendations

From the findings of this study, the following recommendations are made:

1. Strict measure will be employed to ensure that would- be chemistry teachers learnt LMS very well before giving them to certificate to go and teach.
2. Chemistry teachers should be involved in routine retraining, workshops and seminars to help them acquire the skills as well as to keep them abreast with the important LMS for effective teaching and learning of chemistry.
3. Chief-supervising principals should be visiting schools more often to check for chemistry teachers' application of LMS and to advise them on their importance in science and technological growth.
4. The government and interested non-governmental organization should also equip the chemistry laboratories adequately to encourage the teachers to conduct chemistry practical lessons as and when due, to give them the opportunity to constantly applied LMS.

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