# The Use of Laboratory Method in Teaching Secondary School Students: a key to Improving the Quality of Education

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**Abstract**-laboratory experiences have been reported to promote central science education goals including the enhancement of students' understanding of concepts in science and its applications; scientific practical skills and problem solving abilities; scientific 'habits of mind'; understanding of how science and scientists work; interest and motivation. This paper looked at the use of laboratory method in teaching secondary school students: a key to improving the quality of education. It highlighted the concept of science laboratory, quality education. It examined the role of laboratory method of teaching in improving the quality of education, strategies for effective use of laboratory method and the problems facing the effective use of laboratory method in teaching science. The paper recommend among others: Teachers, Laboratory Attendants and Gardeners must be made to attend, at regular intervals, relevant workshops, seminars, conferences and shorts courses that will update and upgrade their knowledge and experiences from time to time and Government should provide Physical resources, and curriculum development that will enhance the use of laboratory method and improve the quality of science instruction in our schools.

**Keywords:** Quality Education, Laboratory, teaching strategies, Teaching, Science.

## 1 INTRODUCTION

FOR a country to develop, it must have adequate human capital to do so. The human capital is obviously obtained through sound education. It is believed that education is a pivotal part of human development, and can positively influence standards of living, health and governance. Schools handle the important responsibility of imparting education to students and developing them into responsible and enterprising citizens. This can only be achieved when the quality of education provided is the top priority of every government and the school in particular. (Salmi, 2000).

Quality education in schools has been a topic of discussion everywhere. There are numerous questions concerning the issues and problems existing in the Educational Systems as to how we can resolve it and the best way we could to attain that kind of quality of education we have been searching and longing for. Where do we begin and how do we respond to such? (Sally, 2010).

Nevertheless, the goal of improving educational quality is agreed by all and stimulated further by the recent worldwide economic downturn and the need to counteract the impact of the crisis on economic growth and prepare for economic recovery. Most governments have set good guidelines and policies on education but what is lacking is the ability to implement such in accordance to the needs of every school, majority of which belong to the public education system.

Generally, education aims to provide quality and free education both for the elementary and secondary public schools but again this have not been observed and understood well causing it to be a burden most especially to the students and parents. Declining standards in public schools is one of the most controversial education issues today and this has contributed to continuing decline in student learning. (UNESCO, 2005).

Nigeria has a strong political commitment to quality education. Quality of education is one of the country's key education objectives – alongside universal Basic education (UBEC) up to lower secondary level, access to life-long learning, community participation and improved resource management. It has developed a rigorous programme to support disadvantaged children through, for example, building new schools, abolishing primary school fees and making textbooks available without charge for poor children in primary schools. (Kofo,2012).

Science educators have believed that the laboratory is an important means of instruction in science since late in the 19th century. Laboratory instruction was considered essential because it provided training in observation, supplied detailed information, and aroused pupils' interest. These same reasons are still accepted almost 100 years later. In a laboratory, students work individually or in small groups on a question, problem or hypothesis. They use the

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processes and materials of science to construct their own explanation of scientific phenomena. The distinction between laboratory and traditional classroom learning is that activities are student-centered, with students actively engaged in hands-on, minds-on activities using laboratory techniques.(Lazarowitz and Tamir 1994).

Agbogun, (1991) reported that; Laboratory method is a unique source of quality teaching and learning in science because science students are able to observe and manipulate materials to demonstrate certain aspects of the subject matter which has been learnt in class through lectures, discussions and textbooks. Hence, laboratory method provides students with opportunities to engage in processes of investigation and inquiry which is believed to enhance quality education.

## 2 QUALITY EDUCATION

Bernard, (1999) define quality education as one were you leave able to go out into the working world and have the skills and knowledge to do the job you choose. It is also education that really improves a person's life and sticks with them letter in life when they need it. Education should include teaching someone how to think critically and with common sense. Quality Education is a system of learning that produces well educated individuals who can handle matters of concern within their area of study proficiently.

Furthermore, it is a Processes through which trained teachers use child-centred teaching approaches in well-managed classrooms and schools and skilful assessment to facilitate learning and reduce disparities which in turn bring about Outcomes that encompass knowledge, skills and attitudes, and are linked to national goals for education and positive participation in society. The system should in addition impose desirable qualities such as moral ethics in the individuals.(UNICEF, 2000).

## 3 SCIENCE LABORATORY

Laboratory has been described as a room or a building specially built for teaching by demonstration of theoretical phenomenon into practical terms. With the laboratory experience, students will be able to translate what they have read in their texts to practical realities, thereby enhancing their understanding of the learnt concepts. Farombi (1998) in Yara (2010) argued the saying that seeing is believing is the effect of using laboratories in the teaching and learning of science and other science related disciplines as students tend to understand and recall what they see more than what they hear. Laboratory is very important and essential to the teaching of science and success of any science course is much dependent on the laboratory provision made for it. Lending credence to this statement, Ogunniyi (1982) in Yara (2010) said that there is a general consensus among science educators that laboratory occupies a central position in science instruction. It could be conceptualized as a place, where theoretical work is practicalized and practicals in any learning experiences involve students in activities such as observing, counting, measuring, experimenting, recording and carrying out fieldwork. These activities could not be easily carried out, where the laboratory is not well equipped. There is usually a strong move to emphasize the dependence of science teaching on the existence of a well-equipped science laboratory.

## 4 ROLE OF LABORATORY METHOD OF TEACHING IN IMPROVING QUALITY EDUCATION IN NIGERIA

Laboratory activities have long had a distinctive and central role in the science curriculum and science educators have suggested that many benefits accrue from engaging students in science laboratory activities (Hofstein and Lunetta, 2004; Tobin 1990; Hodson, 1993; Lazarowitz and Tamir, 1994; Garnett et al., 1995; 26

Lunetta 1998; Hofstein, 2004; Lunetta *et al.*, 2007). At the beginning of the twenty-first century we are entering a new era of reform in science education. Both the content and pedagogy of science learning and teaching are being scrutinized, and new standards intended to shape and rejuvenate science education are emerging (National Research Council, 1996; 2000). The National Science Education Standards (NRC, 1996) reaffirm the conviction that inquiry in general and inquiry in the context of practical work in science education is central to the achievement of scientific literacy and quality education. Inquiry-type laboratories have the potential to develop students' abilities and skills such as: posing scientifically oriented questions (Krajcik et al., 2001; Hofsteinand Mamlok-

Naoman, 2007), forming hypotheses, designing and conducting scientific investigations, formulating and revising scientific explanations, and communicating and defending scientific arguments.

Tobin (1990) wrote that: "Laboratory activities appeal as a way to learn with understanding and, at the same time, engage in a process of constructing knowledge by doing science". He also suggested that meaningful and quality learning is possible in the laboratory if students are given opportunities to manipulate equipment and materials in order to be able to construct their knowledge of phenomena and related scientific concepts.

Gilbert (1994) and Hodson (1996) in Yara (2010) also lent credence to the significance of laboratory method in the learning of science. In their submission, they identified six major significance of laboratory method in promoting quality and effective learning of science and these are where adopted by this paper as follows:

I Motivating students by stimulating interest and enjoyment

Ii Teaching laboratory skills

Iii Assisting concept acquisition and development

Iv Developing and understanding of scientific inquiry and developing expertise in conducting inquiries

V Encouraging social skills development

Vi Inculcating the so-called scientific attitudes

Adeyegbe (2005) in Yara (2010) listed laboratory adequacy as one of the factors that affect the learning outcomes of students. In terms of academic achievement,

Adeniran (2006) in Yara (2010) that laboratory instructional strategy gives a new approach to science teaching and learning because it provides a non-threatening, realistic and concrete approach to learning of science as opposed to the difficulty encountered in learning the formal, abstract treatment of the typical textbook. Oyedeji (2000), discovered that students taught with science Laboratory Instructional Strategy performed significantly better than use of traditional lecture and text book method.

The most effective vehicle by which the process of inquiry can be learned appears to be a laboratory method where the student experiences, firsthand, the inquiry process. Laboratory method has also been demonstrated to be effective means for comprehension, understanding and application of scientific knowledge. Laboratory experiences provide opportunities for teachers to model best practices in the study of scientific concepts, including application of scientific methodologies, respect for life and the environment, inclusion of learners of all abilities, and consistent adherence to safety standards. Thus, study in a laboratory is an integral and essential part of science courses. (Odubunni, and Balagun, 1991).

Typically, the terms have meant experiences in school settings where students interact with materials to observe and understand the natural world. Some laboratory activities have been designed and conducted to engage students individually, while others have sought to engage students in small groups and in large-group demonstration settings. Teacher guidance and instructions have ranged from highly structured and teacher- centered to open inquiry.(Hofstein and Mamlok-Naaman, 2007).

## 6 STRATEGIES FOR EFFECTIVE USE OF LABORATORY METHOD

In this paper the following strategies were adopted as they relate to laboratory method of teaching science particularly secondary school.

### 6.1 Laboratory Demonstrations

It begins by demonstrating key techniques or equipment operation or describing the location and handling of special materials. The students are gathered close to focus them on what you are doing and to ensure that everyone can see and hear. Again, they are focused on the key terms and functions that are in the procedures, and use the demonstration to generate excitement about the laboratory. The teacher should not attempt to demonstrate equipment he has not practiced using. If the teacher made mistake during his demonstration, it is instructionally important to describe how he made the mistake, it is good to familiarize him with the equipment operation prior to the demonstration. ( Allen, *et al*., 2009).

### 6.2 Laboratory Instruction

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A good science teacher should maintain an active role and consistent pace of interaction throughout the laboratory period so that students learn what to expect from him as an instructor. He should include several moments of whole class instruction at key points in the laboratory. When the teacher is asked the same question three times, or three groups have the same problem, it is likely that other groups will have the same question or problem as well. He should gain everyone's attention and use this moment to provide targeted "just in time" instruction or feedback for everyone. During the class, he should move around the room to make himself accessible to students, focusing equal time on groups that ask and those that don't ask for help. He should be aware of the progress of all student teams, address students by name whenever he get the chance, and listen to what is being said in groups to help you anticipate and diagnose instructional problems. He should not assume that since a group is quiet, they know what they are doing. He can diagnose a laboratory problem early on by observing what is being done or said in seemingly on-track groups. It is always useful, and never unappreciated, for a teacher to approach a group and prompt them with "he should tell them what he is doing" to find out if they are on the right track.(Allen, et al., 2009).

## 7 PROBLEMS FACING THE EFFECTIVE USE OF LABORATORY IN TEACHING SCIENCE

The use of the laboratory method in teaching science has become a dogma among science educators and teachers. On one hand, they extolled the importance of the use of the laboratory method in science teaching while on the other hand, they only pay "lip service" to its use in practice. Science teachers do not usually find it convenient to make laboratory work the center of their instruction. They usually complain of lack of materials and equipment to carry out practical work. At the same time, it is possible that some of these materials and equipment may be locked up in the school laboratory store without teachers being aware of their existence. The conditions under which many teachers function do not engender any enthusiasm to use the laboratory method of teaching science even where they know that these materials and equipment are available. Class size in urban schools is getting larger and this does not usually encourage teachers to use the laboratory method to teach science. In some states of the country, teachers go for months without salary owing to shortage of funds. Science teachers who fall in this category cannot reasonably be expected to give off their best to their students. Higher institutions in Nigeria charged with the responsibility of training science teachers at all levels, are increasingly turning out teachers without requisite laboratory experience. A common reason usually given is shortage of laboratory facilities. Such trained science teachers usually lack the necessary confidence to conduct practical classes with their students. It is only accreditation exercises that are improving this situation in Colleges of Education and Universities at present. Such governments see, to have given up on their capacity to equip all school laboratories. They have therefore resorted to designating selected schools as "science schools" that they equipped with their meager resources. They usually used the traditional help received from the Federal Government in equipping school laboratories for these science schools. The condition of the national economy continues to deteriorate without any sign of improvement in sight.(Abimbola, 1996).

In addition, most of laboratory classroom are not equipped with work tables that have sinks, a water supply, and natural gas and electrical outlets available in sufficient quantity to support a laboratory based science courses. There is no enough allocation of funds to provide opportunities to learn in an inquiry-based curriculum. There are no approved guidelines for the safe use, maintenance storage and disposal of laboratory materials. (Abimbola, &Danmole, 1995).

## CONCLUSION

Quality education is achieved when science laboratory and the laboratory in the context of teaching and learning science is made relevant regarding research issues as well as developmental and implementation issues. It is quite obvious that the laboratory space should be available to the teacher during the planning and preparation period and available to students for special projects, makeup laboratories, etc. outside their regular class hours. Each student should have his/her own

laboratory work space. To that end, science teachers must be provided with an annual budget sufficient to purchase both expendable material and equipment necessary to conduct inquiry-based learning that is believed to enhance quality learning.

## RECOMMENDATIONS

The following are recommendations made regarding the use of laboratory method in improving the quality of education;

Government should provide Physical resources, and curriculum development that will enhance the use of laboratory method and improve the quality of science instruction in our schools.

Adequate ventilation, fume hoods, reference materials and laboratory size must be constructed in such a way to allow all students to participate in real hands-on activities.

In the laboratories there should be adequate space for storage of materials and secure areas for storage of solvents, reactants, or potentially hazardous or dangerous chemicals as per guidelines set by the American Chemical Society.

Facilities should be inspected for structural and configuration updating from time to time.

There should also be a space dedicated to growing living specimens for study in biology classes (biological garden).

A student-to-instructor ratio in the science laboratory classroom must permit safe and effective instruction.

Due to the extra time and preparation that laboratory courses require, life science teachers should not be assigned more than five classes per term or semester.

Since each laboratory requires a different repertoire of organisms, equipment, materials, supplies, solutions and planning, and also demands lessons plans and grading time, teaching load should not be more than two process-oriented science course preparations.

Teachers should have their own science classrooms and have access to those classrooms during their preparation times. Time must also be allowed within the teaching day for the setup and dismantling of laboratory preparations.

Where possible, student or adult laboratory assistance should be provided. In high school, there is needing of laboratory manager (or instructional aid) be hired to assist in preparation, setup, and dismantling of laboratory materials for experiential learning lessons.

Teachers, Laboratory Attendants and Gardeners must be made to attend, at regular intervals, relevant workshops, seminars, conferences and shorts courses that will update and upgrade their knowledge and experiences from time to time.

Government need to take the initiative to improve the infrastructure and the curriculum drafted for every school.

Science education community and especially the research community must be careful to provide detailed descriptions of the participating students, teachers, classrooms, and curriculum contexts in research reports. Among the many variables to be reported carefully are (based on: Lunetta et al., 2007): learning objectives; the nature of the instructions provided by the teacher and the laboratory guide (printed and / or electronic and / or oral); materials and equipment available for use in the laboratory investigation etc.

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