IMPROVISATION IN BIOLOGY TEACHING-LEARNING: A PRAGMATIC APPROACH TO SOLVING THE PROBLEM OF ILL-EQUIPPED LABORATORIES AT POST BASIC EDUCATION LEVEL

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Abstract

Effective teaching for quality science education can only be achieved through "learning by doing" (practical activities) in well-equipped laboratory. The ill-equipped science laboratories have reached an alarming level thereby making learning by doing impossible. This paper takes a look at the concept and skills or techniques of improvising biology teaching equipment (instructional materials) as a viable alternative and a panacea to ill-equipped laboratories in our post-basic education in Nigeria. The paper recommends among other things, that schools should encourage and motivate science teachers to develop basic improvisation skills through the use of raw materials and resource persons in the host community.

Background

The provision of quality education and by extension quality of life is constitutional and social obligation of government to her citizenry if it is to attain sustainable development. Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED 1987 in Onwu 2009). Wasagu (2009) and Mustapha (2009) opined that science education is a crucial factor and a corner stone for sustainable development in Nigeria. In order to transmit science education successfully it must best be learnt by doing in well-equipped laboratory (Maduabum 1984). Learning by doing as a concept has been described as a learning situation where hands-on and minds-on activities or concrete sensory experiences are used to aid understanding of learning. It is student-centered and contrary to traditional lecture-recitation pattern of instruction, which is teacher-centered (Maduabum 1984 and Ajeyalemi, 2011). Therefore, the government of any nation is to foster enabling environment for learning by doing that would guarantee quality science education. This is by making adequate provision of laboratory facilities and equipment, and instructional materials that are necessary for scientific learning by doing. Learning by doing (inquiry-based) is advocated in school science by Wasagu (2009). He quoted an ancient proverb which reads thus:

> Tell me and I forget
> Show me and I remember
> Let me do it and I understand

However, one can say without fear of contradiction that science laboratories at post basic education level in Nigeria are grossly ill-equipped, thereby making it impossible to ensure the practice which could motivate learning by doing and the generation of globally competitive indigenous scientists who are capable of assisting in the realization of the Millennium Development Goals (MDGs). Maduabum (1984) stated

that most of Nigerian secondary school laboratories are poorly equipped. Mustapha (2009) said, teaching facilities such as relevant science textbooks, instructional materials, laboratory equipment etc are either grossly inadequate or non-functional (obsolete) or not even available at all in some school laboratories. Wasagu (2009) cited Kisaka (2004) who reported that teaching and learning resources and facilities are in constant short supply, while laboratories are rare and may not have equipment, very often they exist as empty rooms. Gyuse (2009) also revealed that lack of facilities, teaching materials, laboratory/workshop equipment and other accessories are part of the problems that lead to professional job inefficiency among Nigerian graduates.

These perennial problems without doubt translate into difficulties in science teaching-learning and are reflected in the poor performance of students in science as indicated in Tables 1 and 2. The way out of these problems are numerous but this paper emphasizes the need for improvisation in a typical biology practical in the laboratory.

Table 1: Performance of Students of Niger State Science Colleges in WAEC Examination (2004 – 2008)

Year	No. of Candidates	5 Credits with Eng. & Maths	Mean % Pass
2004	682	08	1.17
2005	709	10	1.41
2006	741	193	26.05
2007	930	136	14.62
2008	1167	126	10.80
Grand (5 year) Summary	**4229**	**473**	**11.18**

Source: Mustapha (2009).

Table 2: Percentage of candidates that passed with 5 credits and above including English Language and Mathematics in Nigeria (2006 – 2010).

Year	WAEC		NECO		NABTEB	
	May/June		May/June		May/June	
	No.	%	No.	%	No.	%
2006	1171423	22.15	929003	27.07	37288	40.9
2007	1267 64	20.71	10006114	30.79	39466	42.1
2008	1354478	26.63	1145742	57.22	42732	38.01
2009	135753	26.56	1184907	10.67	42662	29.45
2010	1315786	23.36	1132357	9.36	63612	29.86
2011	1524891	30.90	1169951	8.06	109416	29.83

Source: Daily Trust: Thursday December 2011.

Causes and Consequences of Ill-Equipped Laboratories for Biology Practical in Nigeria

To Uduigwomen and Ozumba (2004) and Eniayegu (2010), the quality of Nigerian education in the 1970s was the pride of the black race, the envy of many developing and developed nations of the world. After about three decades, the education has plummeted and deteriorated that today, especially, since the beginning of this millennium, it is a mere shadow of its past glory, a situation caused by the following factors:

i. Systematic mismanagement by three decades of Military rules, who lacked political will, hence, exhibited lackadaisical attitude towards education issues and trivialization of education values was the order of the day (Kolo 2005).
ii. Underfunding of education has been identify by Uduigwomen & Ozumba (2004), and Kolo (2005) as another cause of ill-supply of laboratory facilities and equipment where they said, the money allocated to education falls kilometers short of the United Nations Educational Scientific and Cultural Organization (UNESCO) recommendation of 26% of annual national budget.
iii. Ogunniyi *et al.,* (1992) in Eniayeju (2010), pointed out that, since the period of Structural Adjustment Program (SAP) and now global financial crisis, the condition of science education has deteriorated considerably in Nigeria.
iv. Kolo (2005) also mentioned perpetration of endemic and brazen corruption in the education system coupled with geometrical increase in enrolment without concomitant expansion of school facilities and equipment led to congestion, students outnumbered available equipment and population explosion in our colleges (science colleges inclusive).

Consequences

The ill-equipped science laboratories is a clear signal to poor practical activities (no enabling environment for learning by doing) in the schools science subjects which leads to the following consequences according to Julius (2011)

i. Neglect of practical activities.
ii. Rendering science teaching and learning too hard to understand.
iii. Making science learning very boring and uninteresting to learners.

Falayajo, Makoju, Okebukola, Onigha and Olubodun (1997), Yesufu (2000), Baikie and Olaofe 2002 in Kolo (2005) added to aforementioned negative effects of ill-equipped laboratory to the society as:

i. Abysmal quality of education and indefensible certificates.
ii. Unemployability of many products (graduates) of the system by the society.

Concept of Improvisation

Improvisation can best be described as an "escape route" or "a way out" for teacher and the pupils/students, when they are faced with the problem of lack of instructional materials (Maduabum, 1984). Improvisation could also be defined as using alternative materials or equipment obtainable from the local environment, designed or constructed by the teacher(s) or with the help of local person(s) to facilitate instruction (Balogun 1982 in Shehu, Mohammed and Tambuwal 2010). Various authors have further described the concept 'improvisation' in different ways Ogunbiyi, *et al* (1990 in Ige 2009) define it as the act of substituting for the real thing that is not available. Bajah (1991) in Ige 2009) takes it to be the use of substitute equipment where the real one is not available.

It is an attempt to bring the life-like situation into the laboratory in the absence of real objects or materials. Improvisation cannot serve as a substitute for ready made materials or teaching aids. In the process of improvising caution must be taken about the kind or nature and purpose of instructional object or material the teacher is improvising. The whole mark of improvisation in the process of teaching and

learning is to ensure that concepts, ideas and principles are clearly made open and clear to the students through effective display, demonstration and illustration (Okai, Odiachi, Taidi, Garba and Yusuf, 2005).

Merits of Using Improvisation in Biology Teaching and Learning to Learners

The following are the advantages of improvisation to science students.

i. It enhances retention and makes learning permanent.
ii. It makes the lesson real and learning more interesting.
iii. It enhances creativity on the part of the science teacher and pupils when they are involved,
iv. It is cheaper to get than the real object especially imported ones
v. It saves money.
vi. It is a source of generating funds for the science teacher as well as for the school.
vii. It enhances high mastery of science contents taught on the part of learners (Babajide and Agoro 2010).

Merits of Improvisation to the Society

According to Wasagu and Muhammad (2009) improvisation activities have the following advantages to the society.

1. Techniques of improvisation serve as scion of entrepreneurial skills for students and hence guarantee self reliance.
2. It inculcates technical skills and practical dexterity on science students to use their hands, heads and hearts to introduce and operate new productive processes for technological invention and economic development.

Sources of Raw Materials for Improvisation

Homes:

They are rich sources of discarded plastics, tins, old calendars, medicine bottle, pots, plates, drinking straws, strings, bulbs, bottle tops, old newspapers, coconuts shells, match boxes and other packaging containers etc. (Maduabum, 1984).

Workshops in the Community:

Saw dust and pieces of wood can be collected from the carpenter's shed. Pieces of rods and metal plates from the blacksmith and welders workshop, pieces of cloth from the tailor, old wheels, spokes, hubs, metals balls of various sizes from the bicycle repairer, pieces of wire and cables from the electrical workshop. (Okai *et al*, 2005).

Rivers and Sea Shores

Where applicable, would yield smooth stones of various sizes, sand, clay, shells and reeds. Farms and forests would give us seeds, nuts, plants, stalk, wood, ropes, bamboo stems etc.(Okai *et al*, 2005).

Improvisable Materials by Modeling or Charts

S/No.		Description
a.		Models and charts
	1	Skeletal system
	2	Muscular system
	3	Brain and nervous system
	4	Circulatory system
	5	Digestive system
	6	Eye and Vision
	7	Ear
	8	Skin and Excretory Organ
	9	Genetic modes

Source: NCCE (2008)

Presented hereunder is a table of objects that can be improvised by a science teacher out of creativity and talent by acquisition.

Table 3: Some Improvisable Objects for Biology Teaching and Learning

Improvised Items	Standard Original Items	Purposes
Candle	Bursen Burner	Heating
Feeding Bottle	Measuring Cylinder	Measuring volume
Tea spoon	Spatula	Dispensing
Ear/eye medicine dropper	Dropping pipette	Dropping indicators
Transparent rubber container	Aquarium	Aquatic animals
Disposable syringes	Test Tube	Boiling/testing
Lids of plastic container	Petric dishes	Display/Drying
Plastic basin	Trough	Gas preparation
25liters plastic can	Installing tap	Water supply
Plastic bottles	Titration flasks	Titration
Hibiscus flower	Methyl orange	An indicator
Lemon juice	Organic acids	Experiments
Dissolved wood ashes	Sodium hydroxide	Acid/base titration
Small locozade bottle	A conical flask	Measurements
Dead electric bulb	Round bottom flask	Heating
Drinking straws	Delivery tubes	Experiment
Bottle Lemon juice & Baking powder	Fire extinguisher	Putting off fire
Clay	Plasticine	Making models
Dead electric bulb with water	Hand lens	Magnification

Source: (Ige 2009)

Table 4: Some Selected Biology Materials With Techniques of Improvising them.

Biological Equipment	Local Materials to Use	Procedures for Improvisation
Dissecting board	Wood, Nail, Flat wood	— Cut a rectangular frame from a sheet of wood — Seal each edge of the rectangular frame with small piece of wood using nail
Quadrant	Wood Nail Flat wood	— Cut thin slice of wood into four equal pieces — Join the 4 pieces together with nail to form a square
Wind vane	Metal bar, pipe, bolts and nuts	— Place a small pipe on top of a bigger one and weld them together;- place two bars on top of the small pipe and use bolts and nuts to tight them together
Rain Gauge	3 plastic containers (2 small and 1 big) sand, plastic funnel	— Fill a bigger (first) plastic container with sand; — Insert the smaller (second) container inside this; — Insert a third smaller container in the second container — Insert plastic funnel inside the smaller container.
Vacuum flask	2 plastic or metal containers (1 bigger and 1 smaller) sawdust, glue, tin cutter	— Remove the bottom of a bigger tin with the aid of the tin cutter; — Insert a medium sized tin into the bigger tin; — Seal the outer surface of the smaller and bigger tins with the mixture of sawdust and glue — Fill the inner surface with sawdust seal the bottom plate with a mixture of saw dust and glue.
Aquarium	Glass sheets Silica gum	— Cut glass sheet into required sizes seal the base sheet

	Water Fishes Flower Air pipe	with the other four sheets to form a cavity leaving the top open — Allow to dry;- pour water unto the cavity and test for leakage — If there is no leakage, put life fishes, air pipe and flowers unto the cavity — Seal the cover with silica gum
Test tube	Fluorescent tube acetone Heating apparatus	— Cut the tips of the fluorescent tube to — expose the inner cavity — Wash the inner cavity with acetone to remove the gas present — Heat the test tube at the middle — When soften, draw the tube to make it thin — Twist to seal one end of the thin tube leaving the other end open
Dropping pipette	Fluorescent tube acetone Heating apparatus	— Cut the tips of the fluorescent tube to expose the inner cavity Wash the inner cavity with acetone to remove the gas present — Heat the test tube at the middle — When soften, draw the tube to make it thinny — Avoid twisting to leave the two ends open

Source: Ige (2009)

Techniques of Improvisation through Import Substitution

Imported plant press: which is usually expensive can be substituted by old newspapers with a heavy support (e.g stone) incorporated to provide the desired pressure.

Storage of specimens: The conventional specimen bottles can be substituted with cheaper, large, wide-mouthed bottles, such as sweet bottles or used chemical bottles.

Mounting of insects: Polythene sheets used as packages for science equipment have been found quite effective as setting and mounting boards for insects.

Running water supply: Plastic cans or buckets provide good substitutes as aspirators.

Reagent bottles: Imported reagent bottles can be substituted with clear or non-coloured soft drink bottles with plastic bottle caps available in local markets, used as stopper or bottle caps.

Beakers: Transparent plastic cups or jars conveniently serve as beakers.

Germination of seeds: Empty milk or soft drink cans satisfactorily serve for **germination of seeds.**

Gas supply: The usual gas fittings and gas supply are substituted with ordinary wick stove. It provides a soot free flame if properly maintained.

Work-table materials: Test-tube stands, holders and reagent racks made by the school carpenter or a local carpenter are suitable and cheaper than imported ones.

Dissection of animals: Similarly, dissecting boards for relatively large mammals such as rabbit or guinea pigs can be obtained at cheaper rates from the school or local carpenters (Maduabum 1984).

Conclusion

This paper concludes that ill-equipped laboratories in Nigeria, caused by underfunding, protracted military rule, global financial crises and brazen corruption in the education sector is one of the current myriad of problems facing biology learning and teaching in Nigerian post basic education levels that need urgent attention. As government alone cannot remedy these problems, other stakeholders in science education need to come in to surmount the problem.

Recommendations

This paper recommends the following:

i. Schools should encourage and motivate science teachers to develop basic improvisation skills through the use of raw materials and resource persons in the host community.
ii. Governments at all levels should increase their wholehearted commitment on science education, whereby educational institutions should be given top most priority, especially in terms of infrastructural and staff development and welfare.
iii. Governments at all levels should legislate stringent penalty on any individual, corporate or education institution that indulges in perpetuating corruption in the education sector.

iv. Parents and the host communities, through Parents Teachers Associations, should assist schools through the provision of laboratory equipment and facilities.

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