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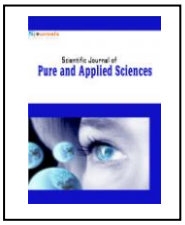

Original article

Improvisation, an alternative approach to solving the problem of ill-equipped biology and agricultural science laboratories in senior secondary schools, Nigeria

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ABSTRACT

Effective teaching for quality science education can only be achieved through "learning by doing" (practical) in well-equipped laboratory. However, 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) in Agricultural science as a viable alternative and a panacea to ill-equipped laboratories in post-basic education in Nigeria. The paper concludes that ill-equipped laboratories is one of the myriad of problems currently facing the teaching and learning of Biology and Agricultural science in Nigerian Senior Secondary Schools that needs urgent attention from all stakeholders in science education as government alone cannot solve the problem.

1. Introduction

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 (Arneh, 1990). Wasagu (2009) and Mustapha (2009) opined that science education is a crucial factor and a

corner stone for sustainable development in Nigeria. Quality science education is best learnt by doing in the well-equipped laboratory (Nwanosike, & Bayero, 2009).

Learning by doing as a concept has been described as a learning situation where hand-on and minds-on activities or a concrete sensory experience are used to aid understanding of learning experiences that is student-centered and contrary to traditional lecture pattern of instruction which is teacher-centered (Maduabum 1984 and Ajeyalemi, 2011). Therefore, the government of any nation should foster enabling environment for learning by doing that would guarantee quality science education. This is by making adequate provision of laboratory facilities, 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) drawing from 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 contemporary 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. These scientists are capable of assisting in the realization of the Millennium Development Goals (MDGs). Arneh, (1990) stated that most of our secondary school laboratories are poorly equipped. Mustapha (2009) said, teaching facilities such as relevant science textbooks, instructional aids, laboratory equipment etc. are either grossly inadequate or non-functional (obsolete) or not even available at all in some school laboratories. Gyuse, (2009) also observed that facilities, teaching materials, laboratories/workshops equipment and other accessories in our schools setting are part of problems that lead to professional job inefficiency among the Nigerian graduates.

All 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.

Table 1

Performance of Students of Sokoto State Science Secondary Schools in West African Examinations Council from 2006–2010.

Year	No. of Candidate	5 Credits with Eng. & Mathematicss	Mean % pass
2006	682	08	1.17
2007	709	10	1.14
2008	741	193	26.04
2009	930	136	14.6
2010	1167	126	10.79
Grand 5 year analysis	4229	473	54.01

Source, Sokoto State Ministry of Science & Technology Sokoto.

Table 2

Percentage of candidates that passed with 5 credits and above including English Language and Mathematics in Nigeria.

Year	WAEC				NECO				NABTEB	
	May/June		November		May/June		November		May/June	
	No.	%	No.	%	No.	%	No.	%	No.	%
2006	1171423	22.15	410139	13.77	929003	27.07	281497	18.08	37288	40.9
2007	1267764	20.71	362676	17.25	10006114	30.79	346815	3.14	39466	42.1
2008	1354478	26.63	359212	22.39	1145742	57.22	296967	28.74	42732	38.01
2009	135753	26.56	331497	30.26	1184907	10.67	234682	1.79	42662	29.45
2010	1315786	23.36	309624	22.09	1132357	9.36	246117	0.16	63612	29.86
2011	1524891	30.90	Exams Still on	Exams Still on	1169951	8.06	Exams Still on	Exams Still on	109416	29.83

Source, Daily Trust Thursday December, 2011.

The ways out of these problems are numerous but this paper emphasizes on the need for improvisation in a typical Biology and Agricultural science practical in the laboratory.

2. Causes and consequences of ill-equipped laboratories for biology and agricultural practical in Nigeria

Nwanosike,. (2008) and Eniayegu (2010) opined that in the 1960s and 1970s, the quality of Nigeria's education 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 to a mere shadow of its past glory. This turnaround was caused by the following factors,

i. Systematic mismanagement by three decades of Military rulers who lacked political will, hence, exhibition of lackadaisical attitude towards education issues and trivialization of education (Kolo 2005).
ii. Underfunding of education had been identified 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 short of the United Nations Educational, Scientific and Cultural Organization (UNESCO) recommendation of 26% of annual national budget of every country.
iii. Ogunniyi et al., (1992) in Eniayeju (2010), stressed that, since the period of Structural Adjustment Program (SAP) to current global financial crisis, the conditions of the world of science education have deteriorated especially 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 leads to congestion, students outnumbered available equipment and population explosion in our colleges (science colleges inclusive).
v. Using art inclined personnel to manage science schools, where the personnel see nothing good in spending huge amount of money in purchasing laboratory facilities (Nwanosike, & Bayero, 2009)

3. 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 instructional materials (Maduabum, 1984). 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 readymade materials or teaching aids. In the process of improvising caution must be taken about the kind or nature and purpose of instructional 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 & Yusuf, 2005). 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 resource person(s) to facilitate instruction (Balogun 1982 in Shehu, Mohammed & Tambuwal 2010). Various authors have further described the concept 'improvisation' in different ways Nwanosike, & Bayero, (2009) defined 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.

4. Merits of using improvisation in biology and agricultural science teaching and learning

The following are the advantages of improvisation to science and vocational education.

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 & Agoro 2010).

viii. Techniques of improvisation serve as a scion of entrepreneurial skill for students and hence guarantee self-reliance (Wasagu & Rabi 2009).

ix. 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 (Wasagu & Rabi 2009).

5. 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 (Nwanosike, & Bayero, 2009).

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 blacksmith and welders' workshops, 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. (Nwanosike, & Bayero, 2009).

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
1	Models and charts
2	Skeletal system
3	Muscular system
4	Brain and nervous system
5	Circulatory system
6	Digestive system
7	Eye and Vision
8	Ear
9	Skin and Excretory Organ
10	Genetic modes

NCCE (2008)

6. The end result

The ill-equipped science laboratories are a clear signal to poor practical activities (no enabling environment for learning by practice) in the schools science and vocational subjects are taught 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.

iv. Scaring students from studying science subjects.

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

i. Poor quality of education and wrong certification of science and vocational students.

ii. Theoretical based of many products (graduates) which render them unemployable in the society.

7. Techniques of improvisation through import substitution

Imported plant pressure, this is usually expensive, but can be substituted by old newspapers with a heavy support (such as 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 sweets bottles, lotion or cream bottles or used chemical bottles.

Mounting Board, 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 transparent soft drink bottles while plastic bottle caps available in local markets can be used as stoppers or bottle caps.

Beakers, Transparent plastic cups or jars can conveniently serve as beakers.

Germination of seeds pot, Empty milk or soft drink cans satisfactorily serve for germination of seeds pot.

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.

i. **Dissection boards,** Dissecting boards for relatively small mammals such as rabbit or guinea pigs can be fabricated at cheaper rates by the school or local carpenters (Nwanosike, & Bayero, 2009)

Dissection Knife, For dissection knife, razor blade can easily be used as been modified by local barbers.

Table 3

Some Improvisable Objects for Biology and Agricultural science Teaching and Learning.

Improvised Item	Standard Original Item	Purpose
Kerosine Stove	Bursen Burner	Heating
Coca-Cola/Pepsi-Cola plastic 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	Petri dishes	Display/drying
Plastic basin	Trough	Gas preparation
25 liters plastic can (Jeri can)	Installing tap	Water supply
Plastic bottles	Titration flasks	Titration
Hibiscus flower	Methyl orange	Indicator
Lemon juice	Organic acids	Experiments
Dissolved wood ashes	Sodium hydroxide	Titration
Lacasera plastic bottle	Conical flask	Measurements
Dead electric bulb	Round bottom flask	Heating
Drinking straws	Delivery tubes	Experiment
Bottled Lemon juice & Baking powder	Fire extinguisher	Putting off fire
Clay soil	Plasticize	Making models
Dead electric bulb with water	Hand lens	Magnification

Source, (Ige 2009).

Table 4

Some selected Biology and Agricultural science materials with techniques of improvising them.

Biological equipment	Local materials that can be used	Procedures/Techniques 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
Quadrat	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	2 plastic containers (1 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 big and 1 small), 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, Water, Fish, Flower, Air pipe	Cut glass sheet into required sizes Seal the base sheet with the other four sheets to form a cavity leaving the top open Allow to dry; pour water into the cavity and test for leakage If there is no leakage, put life fish, air pipe and flowers into 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 soft, 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 soft, draw the tube to make it thin Leave the two ends open

Source, (Ige 2009).

8. Conclusion

The paper concludes that ill-equipped laboratories is one of the myriad of problems currently facing the teaching and learning of Biology and Agricultural science in Nigerian post basic education levels that needs urgent attention from all stakeholders in science education as government alone cannot solve the problem. Ill-equipped laboratories is also one of the current problems facing Biology and Agricultural science teaching and learning in Nigerian post basic education levels that need urgent attention government alone cannot fix, but of all stakeholders of science education to surmount.

9. Recommendations

The paper recommends the following in order to improve the teaching and learning of Biology and Agricultural science at post basic education level,

1. State of emergency should be declared on education by the federal government of Nigeria, during which period, 30% of the national budget should be allocated to education for at least five years. This would improve infrastructural as well as staff development.
2. Governments should establish functional Education Resource Centers in all states of the federation, equipped with qualified personnel and adequately funded to produce standard instructional materials from available local raw materials for schools.
3. Science teachers should be encouraged and supported by school authorities financially in order to improvise appropriate instructional materials to augment commercially manufactured ones.

References

Ajeyalemi, D., 2011. Practical work in school science, Are the aims and objectives being achieved? A memorial lecture. Proc. 52nd Annu. confer. Sci. Teachers Assoc. Niger., (STAN) p.3-13.

Arneh, C.O., 1990. Teaching Science in the 90s. 31st Annu. Confer. Proc. STAN,

Babajide, V.F.T., Agoro, A.A., 2010. Enhancing the teaching of Science in the era of global economic meltdown through improvisation of scientific material. Proc. 52nd Annu. confer. Sci. Teachers Assoc. Niger., (STAN) P.410.

Daily, T., 2011. How Nigerian want mass failure tackled. Thursday, December., 29.

Eniayeju, P., 2010. Where is the STEM? Reflections on the missing context in science, technology, engineering and mathematics instruction. A memorial lecture. Proc. 52nd Annu. confer. Sci. Teachers Assoc. Niger., (STAN,3-8.

Gyuse, Y., 2009. Moving Teaching and Science education forward, Diagnosing Science Teachers Problem. A memorial lecture. Proc. 52nd Annu. confer. Sci. Teachers Assoc. Niger., (STAN) P.3-4.

Ige, A., 2009. Developing improvisation skills among Biology Teachers as a strategy for alleviating education poverty and ensuring self reliance in Nigeria. Proc. 52nd Annu. confer. Sci. Teachers Assoc. Niger., (STAN) P.112

Julius, U.O., 2011. Reform in mathematics through improvisation, a surer option in a period of economic meltdown. Proc. 52nd Annu. confer. Sci. Teachers Assoc. Niger., (STAN) P.306.

Kolo, A.I., 2005. Towards a reform agenda for the education sector in Nigeria, the revamping strategy. Niger state college Educat. Minna., Pp. 2, 6-8, 11&23.

Maduabum, A.M., 1984. Teaching Biology effectively. College of Education Nsugbe, Anabra., P.63, 71 -73.

Mustapha, M.T., 2009. The imperative of Science. Technol. Mathemat. Education for attainment of Niger State vision 3,2020. Niger State College Educat. Minna. P. 3-11.

N.C.C.E (National Commission for Colleges of Education)., 2008. Federal republic of Nigeria Abuja.

N.P.E. (National Policy on Education)., 2004. Federal Republic of Nigeria 4th edition,18.

Nwanosike, M.R.O., 2008. Improving the Teaching of Agricultural Education in Oladeji J.O. Oyebola O.B. & Kwuakan O.T. (Ed) Princ. Pract. Teach. Agric. Educat. Niger. Versatile Publishers, Owerri.

Nwanosike, M.R.O., Bayero, A.A., 2009. Sustainable Vocational and Technical Education for human Development in Nigeria. Paper Presented at the 2nd National Conference of the School of Vocational and Technical Education. Federal College Educat., Zaria. 17th -19th November, 2007.

Okai, U.O., Odiachi, E., Taidi, J.L., Garba, U.K., Yusuf, B., Musa, A., Shehu, B.A., Yabagi, B., 2005. Curriculum and instruction made easy. Niger State College Educat. Minna. P. 132-136.

Onwu, G., 2009. increasing the socio-cultural relevance of Science Education for sustainable development. Proc. Internat. Counc. Assoc. Sci. Educat., (ICASE) p. 32 – 35.
pp 197-201.

Shehu, U., Mohammed, A.U., Tambuwal, M.U., 2010. Integrated Science Education in Global Economic Crisis. Proc. 52nd Annu. confer. Sci. Teachers Assoc. Niger., (STAN) P.200-202.

Uduigwomen, A.F., Ozumba, G.O., 2004. Philosophy and Nigeria's National Policy on Education. The Africa symposium. An on-line Educat. Res. J. A publicat. Afr. Educat. Res. Net., 4 (2), .5-6.

Wasagu, M.A., Muhammad, R., 2009. Developing Entrepreneurial skills through STM Education, A path to the Empowerment of Nigerian Women. Proc. 52nd Annu. confer. Sci. Teachers Assoc. Niger., (STAN) p. 209 – 210.

Wasagu, M.A., 2009. Rethinking Science Education for the changing times, The writing on the wall. The Eighth Inaugural Lecture. Usmanu Danfodiyo University Sokoto.