IMPROVISATION IN SCIENCE LABORATORY TECHNOLOGY COURSES: A WAY FORWARD FOR SCIENCE AND TECHNOLOGY EDUCATION IN NIGERIA

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Abstract

A nation's self-respect, self-reliance, economic and political independence, as well as, integrity and standing among the comity of nations are determined by her achievement in science and technology. In the face of inadequate funding of science and technical education in Nigeria, it has dawned on us as teachers, that one of the ways to cope with the situation is to improvise our teaching materials. This is in recognition of the fact that God has deposited abundant cheap materials in our environment that could be improvised to serve as alternatives to the more conventional, unavailable and costly laboratory materials. This paper, therefore, analyses the need for improvisation and its entrenched constraints alongside suggested materials/apparatus that could be improvised in our laboratories for imparting the knowledge of science laboratory technology.

Introduction

Education is one of the biggest industries in almost every modem economy. This justifies the huge sum of money spent on it. Moreso, education is seen as a panacea for socio-economic development. The Nigerian educational system trains the labour force, advances the frontiers of knowledge, develops and adapts technology to the needs of the society, as well as prepares citizens for life.

Science laboratory technology as a course is offered in Nigerian polytechnics and colleges of technology. Two of the aims of technical education (including polytechnic education) as enshrined in the National Policy for Education (1981) are: (i) to provide people who can supply scientific knowledge to the improvement and solution of environmental problems for the use and convenience of man; and (ii) to give training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant. To buttress this, Decree 23 of 1979 stipulates that polytechnics are to provide full-time or part-time courses of instruction and training in technology, applied science, commerce, management and in such other fields of applied learning relevant to the needs of the development of Nigeria in the area of industrial and agricultural production and distribution and for research in the development and adaptation of techniques.

This means that technical education not only promotes creativity cum innovative skills vis-a-viz improvisation but also channels it towards the rehabilitation of national economies and entrenchment of self-reliance in all facets of national life. Perhaps, this is the reason why Abdullah! (1997) opines that no nation will progress technologically without investing heavily in Polytechnic education. Ezeigwe (1997) posits that (he under funding of educational institutions have generated a number of social economic problems, such as abandoned projects, dilapidated workshops, laboratories, studios and inadequate infrastructural facilities like lecture rooms and libraries.

One canker worm that has constituted a clog in the wheel of science teaching in Nigeria is inadequate science teaching materials which primarily results from the inability of the government to meet the cost of these materials. An attempt, therefore towards finding and using a substitute through improvisation is an innovative effort towards cost reduction in science teaching

According to Osuagwu (1982) in Fagbemi (1998), the idea of improvisation in the context of science and technology teaching has been associated with need, poverty and rehabilitation particularly since the end of World War II. Balogun (1982) regards improvisation as an act of using alternative material or equipment obtainable from local environment, designed or constructed by the teacher or with the help of a local person to facilitate instruction. In the same vein, Eniaiyeju (1983), states that improvisation in science teaching refers to the process of using alternative materials and resources to facilitate instructions whenever there is shortage of some specific first-hand teaching materials.

It is in consideration of the foregoing that this paper presents the problem of inadequate funding of science and technology education alongside some materials/ equipment improvised in the teaching of science laboratory technology courses, and the need for them.

Inadequate Funding of Science and Technology Education

According to Yabani (1982), the Polytechnic and indeed most tertiary institutions are facing critical shortages of funds and resources. Ezeigwe (1997) posits that these problems are compounded by inflationary pressures which have reduced the purchasing power of the Naira and driven most workers below the poverty line. It has also caused brain dram resulting in shortage of teaching manpower and poor quality products.

Purchasing of new equipment and replacement of old ones have been hampered by rising costs due to grossly devalued Naira. An insight into this problem can be gleaned from estimates of cost of equipment required for full accreditation of core engineering programmes in some Federal
Polytechnics presented in Table 1.

Table 1: Inflationary Rate of Costs of Procurement of Equipment for Mounting Engineering Programmes in 10 **Federal Polytechnics Compared** for 1990 **and 1995.**

Institution	Financial Requirements for Programmes in 1990			Total Amount of Revenue in 1990 (Nm)	Total Amount of Revenue in 1 995 (Nm)
	Mech Eng Nm	Electrical/Electronics Eng Nm	Civil Eng Nm		
Ado Ekiti	0.25	3.25	4.22	7.72	73.35
Bauchi	5.72	5.37	4.94	16.03	156.45
Bida	4.68	1.82	1.52	8.02	78.28
Idah	3.97	8.74	6.9	19.61	191.79
Ilaro	11.69	6.22	5.43	23.34	227.80
KLaura Namoda	5.69	3.65	5.24	14.58	142.30
Mubi	6.22	10.40	6.50	23.12	225.65
Nasarawa	13.93	4.00	6.65	24.58	239.90
Unwana-Afikpo	5.81	7.28	3.99	17.08	166.70
Yaba	8.71	12.40	4.51	25.62	250.05
Total	66.62	63.13	49.90	179.70	1,753.87

Source: NBTE Report of the panel on establishment/accreditation of core engineering programmes in ten federal polytechnics cited in Ezeigwe (1997).

Nwaedozie (1997), points out that there is a funding gap between the budgets submitted by the Polytechnic and the government. In fact government subventions to Polytechnics have not kept pace with student enrolment growth. These are shown in Tables 2 and 3.

In appraising the financial predicament of tertiary institutions, Annnu (1983) in Nwaedozie (1997) traced the genesis of shortage of funds as far back as the early seventies. The funding gap between the NBTE (National Board for Technical Education) and actual grants rose steadily from N3.8 million in 1971/1972 to 14400 million annually.

Table 2: Recurrent Funding of Federal Polytechnics 1980 - 1994.

Year	No. of Polytechnics	enrolment	Advance Proposal N'OOO	Unit Cost - N	Amount Received N'OOO	Unit Cost N
A	0	C	D	E	F	G
1980	7	6,799	60,700	8,927	20, 677	3,041
1981	7	9,652	80,000	8,288	20,677	2,!42
1982	7	12,054	93,084	7,722	39,144	3,247
1983	10	13,197	107,331	8,132	39,600	3,000
1984	10	14,726 '	120,078	8,154	41,802	2,839
1985	10	15,477	1 76,500	11,404	38,260	2,472
1986	10	15,000	188.790	12,586	38,539	2,569
1987	10	14,840	195,078	13,145	37,853	2,551
1988	10	1 6,758	206,569	12,326	60,359	3,602
1989	10	19,331	215,086	11,126	71,024	3,674
1990	10	22,242	247,295	11,118	82,028	3,688
1991	11	25,242	256,149	10,148	89,228	3,535
1992	11	27,146	441,827	16,276	252,473	9,301
1993	13	43,405	1,538,048	35,385	710,950	16,356
1994	17	41,980	2,217,997	42,760	952,817	18,330

Source: NBTE Annual Reports and Budget Summaries cited in Nnebe (1997).

Table 3: Capital Funding Pattern m Federal Polytechnics from 1980- 1992.

Year	No. of Fed. Polys.	Total Amount Requested for by the Institutions N'OOO	Average Amount Requested by Each Institution N' 000	Total Amount Received N'OOO	Average Amount Per Institution N'OOO
A	B	C	I)	E	F
1980	7	84.32	12.04	49,600	7,085
1981	8	84.32	10.54	49,520	6,190
1982	10	86.00	8.600	47,000	4,900
1983	10	79.80	7.980	42,000	2,200
1984	10	82.30	8.230	22,136	2,2136
1985	10	82.30	8.230	28,707	2,870
1986	10	70.50	7.050	5,677	0.5677
1987	10	105.55	10.555	16,307	1,6307
1988	10	110.62	!1.062	28,473	2,8473
1989	10	129.99	12.999	61,185	6,1185
1990	11	175.00	15.9090	37,436	3,4037
1991	11	215.55	69.595	71,488	6,4989
1992	13	280.50	21.576	75.376	5,798

Source: Nnebe (1997).

The Need for Improvisation

Alonge (1983) in Mohammed (1997) summed up the need for improvisation in science as a way of minimizing cost of equipment/materials, as well as, inexpensive method of widening the scope of enquiry. It provides a means of local application of universality of science and develops necessary science skills, process skills, attitudinal and practical skills needed to function effectively in the society as a professional scientist. Above all, it is needed to provide a cognitive bridge to lead students from abstraction and its attendant or mental indigestion to a nodding acquaintance with reality. It also enables the teacher to think and research for cheaper, better, faster methods of making the teaching/learning process easier for students, hence promote creativity and self-reliance.

According to Bulogun (1982) in Faghcmi (1998), we improvise because 'the economics of education is generally economics of scarcity', that is to say, no matter how generous and rich education authorities might be, they are generally not in position to provide their schools with all they need. Therefore schools and teachers might be obliged to make the most use of what they can get or construct from available materials.

Fagbemi (1998) states that the essence of the use of local materials for science and technology teaching has long been advocated. This is mainly due to the realization that the use of costly imported materials does not provide many

opportunities for helping Nigerian science and technology students to explore and adapt to their environments. Also, emphasis on modern science and technology especially in this computer era has shifted to teaching and learning of science and technology through process-oriented activities. This calls for the use of abundant local materials in teaching science and technology especially at this time Nigeria is facing difficulties in securing adequate foreign exchange for the importation of such materials.

Most of our school laboratories are poorly equipped. The current population explosion in schools, current emphasis and popularity of science and technology subjects in the face of a depressed national economy and shortage of funds justify the need for improvising science equipment. It has, therefore, become pertinent for a teacher of science and technology to be constantly looking for new and better ways in teaching through the use of simple and more accurate apparatus, conduct interesting and instinctive experiments so as to make learning more novel, pleasurable and effective. This is because it is scientifically believed and accepted that all senses are called into use when improvised instructional materials are used in teaching and learning.

Improvised Materials/Equipment in Science Laboratory Technology Courses

Students pursuing science laboratory technology programmes in the Polytechnics study Biology, Chemistry, Physics and Mathematics related courses.

In Biology and Biology related courses the materials that could be improvised include:

1. Using empty cylindrical cans of beverages and plastic funnels in place of glass beaker and glass funnel for the construction of rain guage.
2. Use of empty cylindrical cans of beverages for constructing the pooter apparatus for insect collection.
3. Use of circular white plastic lids of empty plastic cans and strings in the construction of secchi disc used in the measurement of depth of light penetration/ turbidity of a water body.
4. Use of newspaper as herbarium sheets, cardboard sheets as driers and corrugated carton sheets as ventilators in dry preservation of plants parts on herbarium sheets.
5. Construction of small pond near the laboratory for regular supply of aquatic micro-organisms for practical demonstrations.
6. Preparation of permanent slides of specimens in the laboratory as against the purchase of same from science equipment stores.
7. Use of cotton wool, polystyrene, and copper wires as stuffing materials and transparent beads as eyes of animals in taxidermy.
8. Construction of quadrats for population sampling using bamboo and tendrils of climbing plants.
9. Construction of a wire loop using glass tube and copper wire sealed inside it by means of a flame.
10. The use of gum Arabic and starch solution as mountants.
11. Production of antibiotics discs using punched discs from filter paper impregnated with drugs and dried in an oven used to test the clearing on culture medium.
12. Construction of manometer using glass tube bent into U-shape using flame and Kerosene mixed with crystal violet as the fluid.
13. Polystyrene used in packaging electronics is used as setting and mounting boards for insects.
14. Local production of skeletons of animals against buying them from science equipment stores.

In Chemistry and Chemistry related courses, the improvised materials include:

1. Use of bamboo material as cork for chemical bottles.
2. Use of kerosene stoves in place of bunsen burners.
3. Use of malt bottle for the storage of chemicals which require dark bottles such as silver nitrate.
4. Use of methlylated spirit lamps in place of bunsen burner.
5. Construction of a simple filtration device in place of suction pumps.
6. Use of polystyrene sheets for construction of a calorimeter case.
7. Plastic 'jerry cans' and pots could be used for storing solutions in place of standard reagent bottles.
8. Transparent plastic cups could be used as beakers and conical flasks.
9. Molecular models can be constructed using mud for teaching the molecular structures of some

compounds, such as, diamond or graphites.

Mohammed (1997) suggested some low cost improvised materials in Physics and Mathematics.

In Physics and Physics related courses, improvised materials include:

1. A locally made wood box with a hole at one side using a white piece of paper to serve as screen could be used in place of an imported pinhole camera.
2. A simple pulley can be constructed in form of a toy wheel using a wood to demonstrate the mechanical principles of a machine.
3. A clinical string with one end open, a string and a weight can be substituted for the originally made spring balance for the determination of relative density of solids and liquids.

In Mathematics and Mathematics related courses, the improvised materials include: 1. Models of geometrical shapes can locally be made, such as nets of cube, cuboids and pyramid on a square base may be cut out of cardboard folded and held securely by tabs at their ends. The drinking straws and wires can be used to form the framework of a cube, cuboid or pyramids for the determination of volumes, surfaces area and their properties.

2. The squares, rectangles and other quadrilaterals and triangles can be cut-off from coloured cards to illustrate different shapes and their properties, strips of cards could be joined end to end in order to form framework of different two-dimensional shapes.

Conclusion

Any effort made towards the rehabilitation of the Nigerian economy with a view to entrenching the culture of self-reliance is worthwhile. Science and technology education are important tools for the accomplishment of these goals. Science laboratory technology course is a practical oriented programme where the soul of business is creativity and innovation, which are undisputable bedrocks for a self-reliant economy.

In the face of dwindling financial and material resources coming from the school management authorities, it has become expedient to take urgent steps to ensure the continual pursuance and accomplishment of the goals of education in rehabilitation of our national economy and self-reliance.

This is partly achieved through the improvisation of materials and equipment in the teaching and learning of science and technology subjects. It is hoped that if the culture of improvisation is vigorously pursued and imbibed by science and technology teachers in our polytechnics, not only shall the national economy be rehabilitated, but self-reliance shall become the order of the day in our national lives.

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