MANAGING PHYSICS RESOURCES THROUGH THE UTILIZATION OF LOCAL MATERIALS IN A DEMOCRATIC ERA FOR SUSTAINABLE NATIONAL DEVELOPMENT

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ABSTRACT

In a democratic era the educational system is expected to thrive but the converse is the situation in most African countries. Nigerian educational policies, though laudable, prove to be mere political expediencies, which underscore the relationship between education and politics. The paper exposes the teacher as a stakeholder in the polity of his nation who must explore ways of sustaining development in the society he lives in. In this regard the physics teacher is faced with a lot of challenges which include finding a way of presenting physics concepts to the learner for effective learning and consequent sustenance of science and technology development. It is in the light of the afore-said that this paper x-rays some local materials that can be used by the physics teacher as a means of managing material resources in a democratic dispensation.

INTRODUCTION

Government of any country is among the agencies responsible for the education of its citizens and, in most instances, it is the sole controlling body. According to Anele in Akpan (2001) affluent people and organizations in oversea countries that spend enormously on education in their countries do so within their various governments' guidelines. They are confined to a boundary of government's rules and regulations or policy formulations. Here in Nigeria educational institutions managed by some wealthy citizens and organizations have since taken off. This is commendable as it is a mere logic that the government of any countries, its citizens and non-governmental agencies should work together for the maintenance of science and technology in the country.

Democracy is the best form of government and a means of sound education, if properly practiced. Sharma and Hyland (1991) view a democratic society as one that is better able to confront new situations, and try new solutions'. However, in an era of democracy where authentic democratic norms are not adhered to the science teacher is required to know how to manage available resources for optimum teaching and learning of science concepts. Genuine democracy which is seen as the government of the citizens, for the citizens and by the citizens has not been reflected in any of the Nigerian democratic government administrations. On Nigerian democratic government and administration of institutions, Akpan (2001) opined that some of the educational policies prove to be mere political expediencies which underscore the link between education and politics.

It is common for a corrupt and inefficient citizen to be 'elected' into a political office through dubious means. Also since democracy in Nigeria is the liberty to behave as one pleases, whether good or bad, science and technology education being an instrument for transformation and development in any society suffers. The government simply pays lip service to education. Josiah and Okooboh (2001), STAN (1999), Josiah, Ade - Afolabi and Archy (2001) and other concerned Nigerian citizens and organizations lament the poor state of education in Nigeria and the poor performance in Sciences at the Senior School Certificate Examination (SSCE) organized by West African Examination Council (WAEC) and National Examination Council (NECO). Even at higher levels such as the Colleges of Education and Universities the story is the same. If Ayodele (2001) recalls that between 1960 and 1979 high performance was achieved at final examinations by students, one then becomes puzzled and is bound to ask 'What might have gone wrong with the education system?

Nigeria is noted for its ability to formulate wonderful educational policies, which, if properly implemented, would lead to tremedous development. Such policies include the National Policy on Education, National Policy on Science and Technology and the Blueprint on Implementation Guidelines for the Universal Basic Education Programme. Some of the policies led to the introduction of Science in primary school, establishment of many government and private - owned Technical Colleges, Colleges of Education (Technical), Universities of Technology and Universities of Science and Technology and the purchase and distribution of science and technical equipment and machinery to schools. However, in consonance with Ganjang and Ganjang (2001), experience has shown that the main hindrance to our science and technology development is the lack of implementation of the policies stemming mainly from poor planning and execution. Furthermore, Science curriculum outcomes depend on facilitating factors such as material resources. Unfortunately, the outcome of science teaching through the employment of these factors have been underscored as agreed upon by Ogunleye (2000) who noted that:

> *Over the years, in spite of concerted efforts that have been put in place at different levels and times to ensure that these factors contribute positively towards the achievement of laudable objectives as specified in the curriculum, unfortunately, it is sad to note that the general outcomes of curriculum instruction at the secondary level of education have been found to be very unsatisfactory and grossly disappointing.*

The unsatisfactory and disappointing outcome of the teaching of science contents at all levels of education must be brought under searchlight if the science and technology development has to be improved upon and sustained. In the Nigerian democracy the physics teacher is faced with a lot of challenges, which include finding a way of presenting physics concepts to the students for effective learning and sustenance of science and technology development. When resources are provided and well - managed learning in such subjects as physics which students dread can be effective. Since democracy is a form of social organization that poses a challenge to the exploration of new ways of addressing the difficulties faced by man (Sharma and Hyland, 1991), the physics teacher must be seen to be a stakeholder in the polity and must expore scientific ways of sustaining development in the society he lives in. The physics teacher, as any other science teacher, who delves into scientific ways of developing science and technology and maintaining such development is only fulfilling the ethos of the contemporary scientific and technological society.

In the light of the afore-mentioned, this writer x-rays some local materials that can be employed by the Physics teacher as a way of managing material resources in the democratic dispensation for sustainable development. The physics teacher is able to contribute his or her quota in sustaining development if he or she is able to make physics teaching and learning effectively by the use of local materials.

IMPROVISATION RESOURCES AND MANAGEMENT OF LOCAL MATERIAL RESOURCES

Hornby (1993) defines resources, among other definitions, 'as something which helps in doing something, that can be turned to for support, help, consolation'. Therefore, resources are objects of study, related to particular concepts, which enhance teaching and learning processes in the school system. These resources are usually utilized to attain the goals or objectives of teaching by teachers and learning by students.

Resources are both human and material (Osiyale, 1998), although, in contrast Williams and Nweke (2000) classify resources in schools into five:

(a) Human resources:- These are the teachers, students and school leaders.
(b) Physical resources:- These are infrastructures such as classrooms and laboratories.
(c) Material resources:- These resources include chalk, black-board, text-books, laboratory equipment and chemicals, projectors, computers and teaching aids.
(d) Time resources:- These include the school calendar, number of periods per week and durations of lesson and test administration.
(e) Financial resources:- These are school fees, subvention, capital and recurrent expenditures, science levy and Parents - Teachers Assocaition (P.T.A.) levy, as well as others.

Management of physics resources then refers to the control or usage of resources such as material resources for the facilitation of teaching and learning of concepts in physics. Hornby (1993) defines a material, inter alia, as that of which something is or can be made or with which something is done'. In the context of this paper, material resources are considered as experimental apparatus or teaching aids that facilitate the teaching and learning of science concepts by the teacher and student respectively. In concordant with Eule and Chukwu (2000) these resources should be within the reach of the teacher at any time they are required for use. The researcher dare say that all material resources, otherwise referred to as non-human resources, can improve teaching and learning if available and well - managed. No Nigerian citizen can be said to be blind to the inadequacy of school resources, especially material resources, let alone the mismanagement of the new available resources. Most of these non-human resources in our schools are insufficient partly because they are imported and partly because of their high cost.

Local materials should be resorted to as they are cheaper, being sourced from within. Local materials are those materials that are readily obtainable within the learning environment and can be utilized to effect teaching and learning. The learning environment here means Nigeria as a country. Alonge (1981) classifies local materials into three:

(a) Household devices in use;
(b) Materials that occur naturally; and
(c) Discarded scraps or waste materials such as dry cells and rods.

Local materials can be well - managed only if they are seen to

(a) Be easily obtainable;
(b) Enhance the required skills and attitudes in students just as the imported materials;
(c) Provide precise solutions to scientific problems;
(d) Motivate the students towards learning.

Students will easily and willingly bring some of the local materials to class for use, when called upon to do so. Therefore the teacher can use the students to help source the local materials required for teaching and learning of Physics concepts.

LOCAL PHYSICS MATERIALS

The physics teacher can manage material resources only when they are available. The ingenious teacher can always source for local materials for use in improving teaching and learning of physics concepts. The table below shows some local physics materials, concepts to be taught and learned with the materials and brief description of activities and observations.

The local materials in the table are only but for few concepts considered by the researcher. Other concepts and materials abound that the teacher can explore.

S/NO	Concept to be taught and learned	Local materials to be utilized	Activity description and observation
1.	Brownian motion	Maize flour, water in a glass beaker or tumbler and a simple magnifying glass	Pour a little quantity of the ground maize flour in the glass beaker containing water. Use the magnifying glass to observe the particles of maize in irregular motion inside the water.
2.	Oscillatory motion and simple harmonic motion	Plaiting thread, a small piece of spherical stone, asbestos, retort stand and clamp or a rectangular - welded metal (about 2m in length) with standing support at the bottom, stop -watch clock	(a) Prune the asbestos into a sizeable cylindrical shape and split into two to serve as a split cork. Tie one end of the plaiting thread on the stone and tie the other end on the retort stand and clamp using the split asbestos. Pull the stone slightly from its vertical position of rest and allow it to perform oscillations. Use the watch to take the time for a number of oscillations.

			(b) In the absence of the stand and clamp use the rectangular - welded metal. Tie one end of the thread on the stone and other end at the middle of the upper horizontal part of the metal. Give the stone a slight pull and allow to oscillate. Use the watch to observe the time for a number of oscillations.
3.	Speed and Velocity	A plank of wood, a pile of blocks or a huge stone, stop watch or clock, distance measuring device (e.g. meter rule) and a toy car.	Place one end of the plank on the pile of blocks or stone and allow the other end to rest on the ground. Put the toy car on the end of the plank that is raised above ground level. Allow it to roll on the plank at the same time starting the watch. Stop the watch when the car reaches the ground. Measure the distance the car has traveled with the meter rule. The speed can be found from distance/time.
4.	Uniform rectilinear acceleratio n.	A plank of wood (about 3m or 4m long), a pile of blocks or a large stone, stop watch or clock, metre rule, toy car, graph sheet, pencil.	Place one end of the plank on the pile of blocks or stone and allow the other end to rest on the ground. Mark out five separate points from the top to the middle of the plank. On each of the points place the toy car and allow it to roll on the plank to the ground. Each time take the time for the car to roll to the ground using the clock. The speed (or velocity) of the car on each of the five instances can be computed. The slope of the graph of speed (or velocity) against time will give the value of the uniform acceleration.
5.	Heat transfer in solids		
		f thin paper, detergent foam, a bowl of clean water, magnifying glass.	Make a sphere out of the wire and place it on the piece of paper. Now place the paper with the wire on the water in the bowl. After some time the paper will sink leaving the wire on top of the water. Observe the wire closely through the magnifying glass to see the depression on the water surface due to the wire. Now use a clean hand to add a handful of the detergent foam on the water. The wire sinks because substances such as detergent reduces surface tension.
8.	Principle of flotation	(a) Balloon, thin thread.	Inflate the balloon and tie it with the thread. Now throw the balloon up and observe that it floats momentarily in air

		(b) Transparent uniform circumference glass tumbler containing water, kerosene or any other substance, test-tube or the straw of an insecticide can, platicine or chewing gum, cellophane.	The tumbler can be used as a measuring cylinder by graduating a strip of paper using a rule and attaching the paper on the external part of the tumbler with cellophane. Pour water into the tumbler and note the level of the water. Pour some kerosene into the straw which is sealed at one end with the chewed gum (paste). The straw is used if there is no test-tube. Also in the absence of plasticine the chewed gum is used. Place the straw inside the water in the tumbler. If the straw bends add more kerosene until it floats upright. Note the new level of the water in the tumbler which will be higher than the initial level.
9.	Conversion of chemical energy to light energy.	Torch, dry cells	With the switch off put the required number of dry cells into the torch. Now switch on the torch. Observe that the chemical energy from the cells is converted to light energy indicated by a glow in the bulb.
10.	Melting point	Stove, box of matches, discarded fine wire mesh (mosquito net) cut into suitable size and used as wire gauze, test - tube, candle wax, thermometer, stop - watch, graph sheet of paper and pencil.	Light the stove with a matchstick and place the wire mesh on the stove. Put some candle wax into the test-tube and place the tube on the stove. Use the thermometer to stir the test-tube content until the wax melts completely. Remove the test - tube and take the temperature every 30 seconds as the liquid solidifies. Continuously stir the liquid. The flat part of the curve when temperature is plotted against time gives the melting point of the wax.
11.	Refractive index	Rectangular glass block, plain sheet of paper, 8 sewing needles, asbestos board (cut from asbestos -	Place the plain paper on the asbestos board and use 4 of the needles to hold the edges of the paper onto the board. Place the glass block on the paper and trace its outline. Remove the block and draw a -

		into suitable rectangular size), pencil, protractor.	normal on one side of the length of the block. Use the protractor to measure angle of incidence $i = 25^0$ and draw the incident ray to meet the normal at the point of incidence. Replace the block. Place two of the remaining four needles on the incident ray (at least 5cm apart). Look through the opposite length of the block and place the remaining two needles such that they appear to be in straight line with the images of the two needles on the incident ray. Remove the block and join the points made by the last two needles. Produce the line to meet the block. Use the protractor to measure the angle of refraction, r. Evaluate sin i, sin r and sin i/sin r. Repeat the experiment with $i = 35^0$ and 45^0, and evaluate sin i, sin r and sin i/sin r in each case. Observe that sin i/sin r = constant and it is called the refractive index of glass.
12.	Sound transmissio n through solids	Two empty boxes of matches, plaiting thread	Remove the outer covers of the boxes of matches and drill a tiny hole at the middle of the base of each container. Cut about 10m of the thread and tie each end on the containers through the holes. Two students can be asked to stretch the thread taut. One of the students should talk to the other one through the container while the second student listens through his container. Observe that sound is transmitted through the thread.
13.	Electrolysis	Liquid Peak milk tin (opened at one end), 6v p.d (obtained by arranging four 1.5v dry cells in series), torch bulb, connecting wires, 2 carbon (graphite) rods sourced from discarded dry cells, distilled water, kitchen salt (NaCl), potash, kerosene.	(a) Connect one end of a wire to one of the carbon rods and connect the other end of the wire to the negative terminal of the 6v-battery arrangement. Connect one end of another wire to the positive terminal of the battery and connect the other end to the bulb. Also connect one end of a third wire to the bulb and the second end to the second rod. Pour distilled water inside the milk tin and partially suspend the rods inside the water. Observer, that the bulb does not glow.
			(b) Connect the circuit as in 13 (a). Pour distilled water in the tin and add a table-spoonful of kitchen salt (NaCl) into the water. Stir to dissolve. Suspend the two rods partially inside the solution and observe that the bulb glows.
			(c) Connect the circuit as in 13 (a). Pour distilled water in the tin and a table-spoonful of potash into the water. Stir to dissolve. Suspend the -

			two rods partially into the solution and observe that the bulb glows, but the strength of the glow is not as in 13(b).
			(d) Connect the circuit as in 13 (a). Pour kerosene in the tin and partially suspend the rods into the kerosene. Observe that the bulb does not glow.

CONCLUSION

Nigeria's development is better measured in terms of the development of Science and Technology and can be sustained only if the quality of science and technology education is improved upon. The unsatisfactory approach to science and technology education by both government and its citizens must undergo a rebirth. Once physics teachers see themselves as stakeholders in the polity of their nation they would contribute their desired quota to the sustenance of science and technology development. The country's vast and rich resources can be utilized by both government and science teachers to sustain development. Moreover, teaching students to relate to their immediate environment is the best way of advancing the country scientifically and technologically.

REFERENCES

Akpa, G.O (2001). "Government and the Administration of institution in Nigeria". COEASU. F.C.E. Pankshin Journal of Educational Issues. 1 (1).

Akpan, E.U.U. (2001). "Government and Science and Technology Education in Nigeria". COEASU F.C.E. Pankshin Journal of Educational Issues. 1 (1).

Alonge, E.I. (1981). "Local materials for School Chemistry in Nigeria: Some crucial Questions, Answered". JSTAN. 20 (1).

Ayodele, S.O. (2001). "The Challenge of Secondary Education in the 21st Century". A keynote address at the CON conferment of Fellowship ceremony, University of Jos. 14th March.

Eule, F.O. and Chukwu, A.C. (2000). "Enriching the teaching of Chemistry in the secondary school: Provision and effective utilization of Resources". 41st Annual STAN conference proceedings.

Ganjang, D.M. Ganjang, R.(2001). "Availability of Human and materials Resources and its implication for the success of the UBE programme: A case study of Bokkos Local government Education Authority, Plateau State". COEASU F.C.E. Pankshin Journal of Educational Issues. 1 (1).

Hornby, A.S. (1993). Oxford Advanced Learners' Dictionary. Oxford: Oxford University Press.

Josiah, M.M. Ade - Afolabi, M and Archy, N (2001). "Enhancing Female Performance in Science Education in Nigeria: A case study of Federal College of Education Pankshin". 42nd Annual STAN Conference Proceedings.

Josiah, M.M. and Okooboh M.A. (2001). "The Role of Government in Science and Technology Education in Nigeria". COEASU F.C.E Pankshin Journal of Educational Issues. 1 (1).

Ogunleye, A.O. (2000). "Towards the Optimal Utilization and Management of Resources for the effective teaching and learning of Physics in schools". 41st Annual STAN Conference Proceedings.

Osiyale, A.O. (1998). "Cost Reduction Strategies for Managing Resources in Education in Nigeria beyond the year 2000". African Journal of Education. 1 (1).

Sharma, A.P. and Hyland, J.T. (1991). Philosophy of Education for Nigeria. Kaduna: Gbabeks Publishers Limited.

STAN (1999). "Under achievement in Science and Technology and Mathematics". STAN Bulletin. 16 (1).

Williams, O.F.I. and Nweke, A.O (2000). Enriching Science, Technology and Mathematics Education in Secondary Schools Through Effective Utilization of Resources in Classrooms". 41st Annual STAN Conference Proceedings.