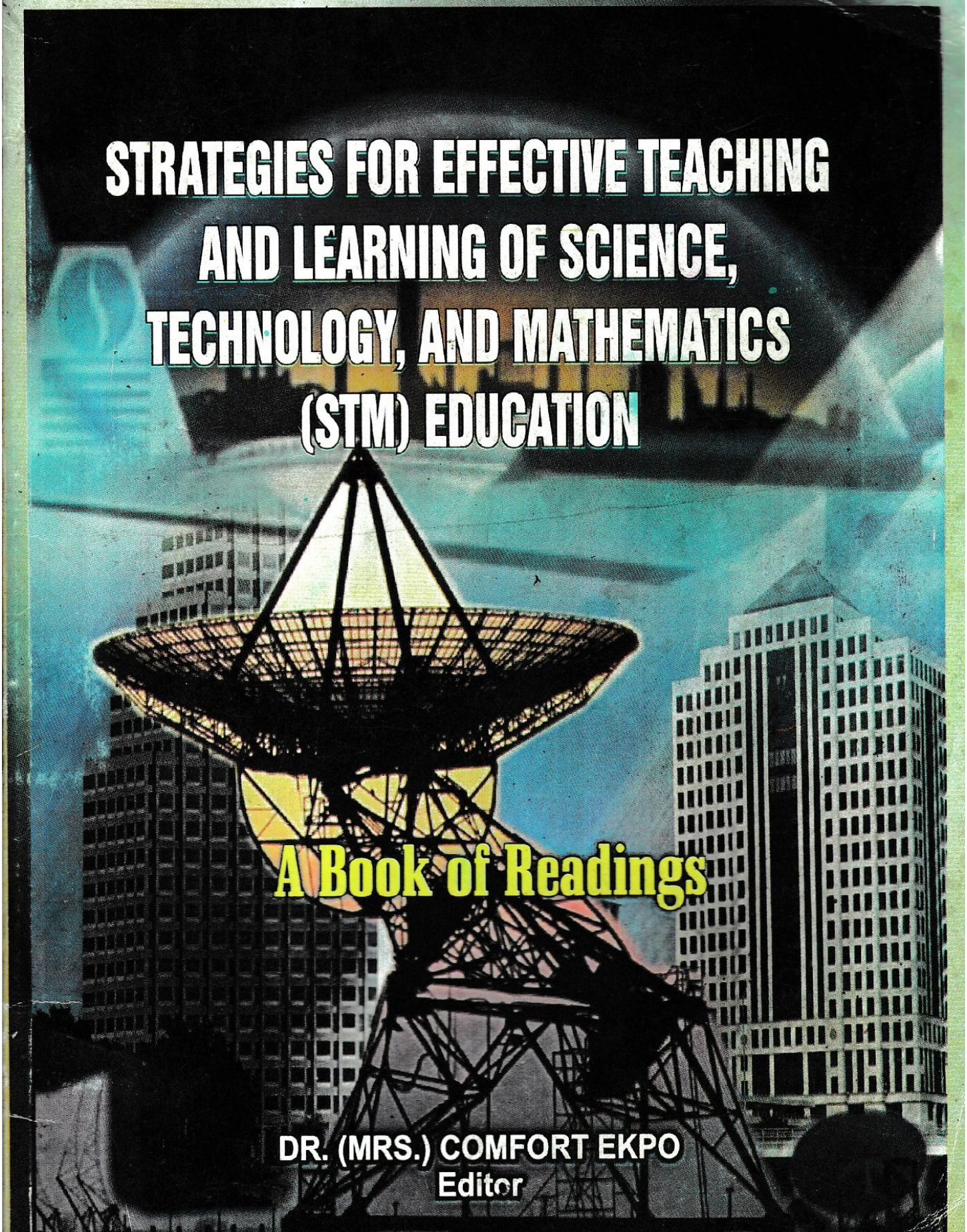
STRATEGIES FOR EFFECTIVE TEACHING AND LEARNING OF SCIENCE, TECHNOLOGY, AND MATHEMATICS (STM) EDUCATION



A Book of Readings

DR. (MRS.) COMFORT EKPO
Editor

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TEACHING PRIMARY SCIENCE IN A PRIMARY WAY

FIDELIS A. ONWIODUOKIT

INTRODUCTION

Science is considered as a body of knowledge that has been systematically acquired. It has both process and product dimension. While the process dimension has to do with the process involved in Sciencing such as observations, hypothesizing, experimenting, etc., the product dimension has to do with the product of science which include scientific facts, theories, generalizations among others. The two dimensions are mutually related and inseparable (Oguniyi, 1986).

Primary Science is not necessarily an elementary science with respect to its simplicity, rather it is fundamental and foundational and hence, very crucial. A good analogy of the importance of primary science is seen in structural design and construction. Usually, the strength and the height of a super structure is determined by the substructure. The foundation of a house determines lots of things concerning the house. The near negligence of the importance of primary science at the tender ages of our children, has contributed in no small way to the chronic poor performances in science noticed among student, especially in eternal examinations. It is perhaps this negligence that has resulted to the need for Remedial Science studies in the Universities and colleges of Education.

Unfortunately, experience has shown that most students still perform poorly even after such remedial studies. This implies that any gap allowed to exist in Science at the early ages is difficult to be filled. The main problems of teaching primary science include the following:

i. Insufficient trained science teachers in the primary schools. In most primary schools, one teacher is still meant to teach all subjects including Science and Mathematics even when he/she is not comfortable with Science;
ii. Insufficient materials for teaching science; and lack of science laboratories in primary schools (Abdullahi, 1982; Ogunniyi, 1986; and Ogunleye, 1999).

PURPOSE OF THIS PAPER

In this Paper, we will try as much as possible to train teachers to teach primary science in a primary way. Experience with primary science teachers especially in public schools, has shown that within the primary

science modules, some concepts are regarded as being difficult among teachers. Most teachers seem to be more comfortable with biological concept than physical. The purpose of his workshop therefore is to demonstrate how such concepts could be taught with ease.

TEACHING SCIENCE IN THE PRIMARY WAY

This has to do with teaching science;

i. in a way that benefits children of primary school age, considering their experience and attitude, and
ii. in a manner that provides a basic foundation for acquisition of science skills at secondary and university levels.

The primary school children are basically curious. This is seen in their numerous questions. They are interested in what goes on around them, wanting to know the causes of natural events around them. Teaching Science to these children one must utilize their curiosity, interest as well as the environment (man-made and natural things a child lives with and handles).

Curiosity, if properly harnessed, using guided discovery approach, could enhance creativity and self-confidence in the children. These qualities are needed for scientific and technological advancement of any nation. For this Paper, we have decided to choose for demonstration, concepts in the senior primary levels often considered difficult among primary science teachers.

CONCEPT 1: Simple Machines

As stated in the primary school Curriculum module, the performance objectives in teaching this concept are that the children will be able to:

i. collect and identify common simple machines;
ii. identify components in any given simple lever machine;
iii. group a collection of simple lever machines and
iv. list common uses of levers.

INTRODUCTION

A machine is a device whereby a comparatively small force applied is used to overcome a larger one. As the name implies, simple machines are simple devices that can assist us in doing some work. They can easily be constructed and made accessible for use. The materials required in constructing simple machines are available locally and are inexpensive. They are found in most homes and technical workshops. The usefulness of simple machine abounds in our homes and technical workshops. Let us use some of them in our activities:

Materials needed include: Claw hammer, kitchen knife, nutcracker, a pair of scissors, wheelbarrow, sugar tongs, cap opener, wooden plank, nails, bottles of coca-cola drink, cement block, a bundle of waterleaf and a jerry can full of water.

Action required:

A: The teacher stands in front of the class with the materials displayed and pose a challenge to the pupils thus:

i. "Who can lift me up? I want to be lifted up." Using play way method he/she subjects himself/herself to pupils attempts. The pupils are not likely to be successful in lifting up the teacher, hopefully.

ii. The teacher now places the plank on the cement block and stands on the shorter arm, saying, "let someone lift me up". Standing on the longer arm of the plank, the pupils will be able to lift up the teacher. This is expected to attract an applause.

iii. The pupils are then made to identify the arrangement as a simple machine and also guided to identify the Load (L), Fulcrum (F) and Effort (E) in the arrangement as well as the direction each is acting.

B: 1. Using the hammer, drive a nail far into the wooden plank provided.

2. Use your hand to remove the nail from the wood. What do you Observe? Try again. Are you successful? Why?

3. Now use the claw hammer to remove the nail. What have you noticed? Have you noticed the ease with which the nail is removed using the hammer? The hammer is a simple machine. It helps us to do the work faster and easier.

4. Now guide the pupils to identify the load (L), Effort (E) and Fulcrum (F). It helps us to do the work faster and easier in this machine.

5. Choose any two or three of the materials provided and show how a Simple machine can make-work easier. Your choice may include the following:
   (a) Kitchen knife with a bundle of water leaf
   (b) Wheel barrow and a jerry can full of water
   (c) A bottle of coca-cola drink and a cap opener, among others.

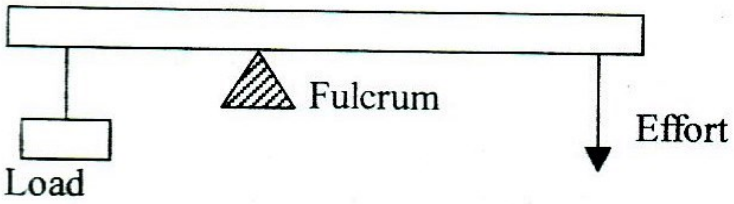
These forms of simple machines are called levers. Levers exist in three classes or orders.

FIRST ORDER OF LEVER

The distinguishing features of the first order lever are that:

(i) The Fulcrum (F) is in between the Effort (E) and the Load (L).

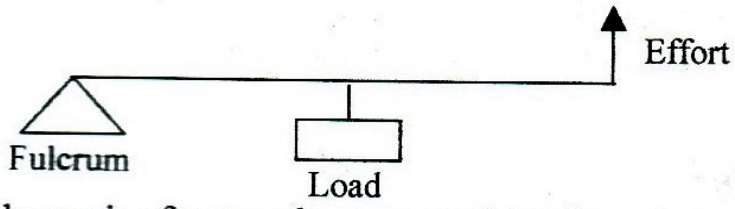
(ii) The Load is closer to the Fulcrum than the Effort. This is shown below:



Based on the activities carried out earlier, and their experiences in the home, ask the pupils to mention some examples of this order of lever. Their examples may include diggers, shovels, a pair of scissors, pliers, pump handle and steelyard.

SECOND ORDER LEVER

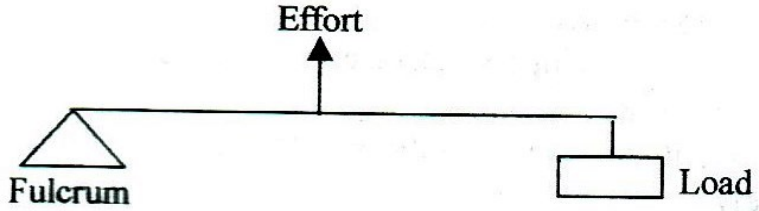
Show the pupils a wheelbarrow and guide them to see how this form of lever is different from those of the first order. In this second order, the Load is between the Fulcrum and the Effort. Moreover the Effort acts vertically upwards as different from the first order where the Effort acts vertically downward.



Examples include a pair of nutcrackers, manual trucks and oar of a boat.

Third Order Lever

Simple machines constituting a third order have the Effort between the Fulcrum and the Load.



Examples include: Sugar tongs; cap opener and table knives.

FURTHER ACTIVITIES

To carry out further activities, the following materials are required:

(a) Pulleys, inclined plane, screw jack, a bag of rice, wheel and axle, a wedge, 50kg weight etc.

(b) A Chart or a picture of someone lifting up a car with deflated tyre with a screw jack and loaders moving bags of rice into a pick up vehicle using inclined planes.

1. Allow the pupils to try to move heavy materials using inclined planes at different angles to the ground surface. Let the pupils discuss their experiences and draw a conclusion that the smaller the angle between the plank and the ground the easier the work.
2. Let the children try to lift up a 50kg weight directly above their heads and narrate their experiences.
3. Using a pulley, demonstrate how this can be done easily. This can be used to move objects up storey buildings. As was the case with other simple machines, guide the pupils to identify the Load, Fulcrum and Effort.

CONCEPT 2: FRICTION

The primary Science Curriculum Module has as the objectives of teaching this concept, such that, the children should be able to:

i. define and give some instances and a natural application of friction in everyday life,
ii. produce and reduce frictional effect through simple activities, and
iii. list useful and harmful effects of friction in everyday life.

INTRODUCTION

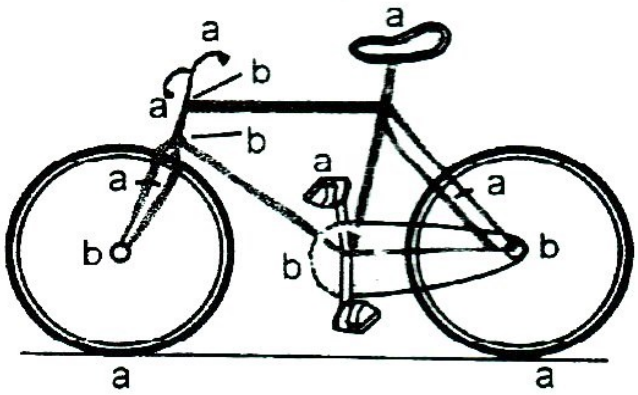
There are simply two types of forces that which aids motion and that which discourages (opposed) motion. The force that opposes motion is called Friction. The students could be involved in the following observations and activities:

i. observe the soles of their shoes
ii. observe a used car tyre
iii. try to walk on a slippery surface with a flat sole shoe compared to walking on a rough surface
iv. attempt to cut something with a kitchen knife after washing clothes immediately
v. pound okro and pepper, respectively
vi. rub two slices of dry or toasted bread
vii. rub a sandpaper against a rough metal surface
viii. rub the palms of your hands vigorously, together and immediately touch your cheeks with them
ix. rub a pebble against a cement floor
x. strike a match
xi. strike the sharp edge of a cutlass against a stone or cement floor and note the results.

In each of these activities, the pupils should discuss their experiences. They should also be guided to identify the merit and demerits of friction as follows:

MERITS OF FRICTION

i. As we walk, frictional force exists between the sole of our shoes and the ground. This is what makes walking possible. Without this force we would have been falling anytime we try to walk. On a slippery ground, frictional force between the sole of our shoes and the ground is reduced. That is why it is difficult to walk on such surfaces.
ii. Frictional force exists between the vehicle tyres and the ground. This force here is specially useful when vehicles negotiate bends without it, the vehicle would skid off the road.
iii. Frictional force exists between brake blocks and the wheels of a vehicle when brakes are applied. This helps the vehicle, to stop when required. Worn out tyres have low frictional force existing between them and the ground. That is why it is not advisable to use worn out tyres on the high way.
iv. In handling things, mostly, frictional force is involved. For example, in cutting using machete, knife, axe or other tools, without friction, the handles of these tools will slip off our hands anytime we want to cut something. Even in handling and writing with a pen without friction between our fingers and the pen, it would be difficult to write.
v. Without friction existing between our buttock and our seats, we would be sliding off our seats each time we move our body on the seat.
vi. When nails are driven into the wall or into woods, it is friction that enables the nail to stay put without coming out easily.
vii. Sharpening of machetes and knives are possible due to friction.
viii. Friction is required principally for the working of a bicycle although in some places friction posses a nuisance.



a – friction useful
b – friction to be reduced.

A bicycle showing places where friction is useful and areas where it is a nuisance.

DEMERIT OF FRICTION

Friction is a nuisance in the following areas. It causes the wearing out in the following areas:

i. Vehicle tyres get worn out because of friction
ii. Brake parts get worn out due to friction
iii. Metal joints get worn out as the two surfaces rub against one another
iv. A duster get finished because of friction
v. Machetes and knives get reduced in width due to repeated filing during which friction occurs.

ACTIVITY

Ask the pupils to mention the merits and demerits of friction other than those shown above.

CONCEPT 3: Bulbs and Lighting

The performance objectives here include the children being able to:

i. Light touch bulb using the materials provided.
ii. Draw the arrangement of battery, bulb and wire that gave light.
iii. Use more than one battery to light a bulb and record their observation.

PRESENTATION

As it was with other concepts, guided discovery approach could also be used in teaching this concept.

MATERIALS NEEDED

These may include torch, dry cells, circuit boards, connecting wires, key, torch bulbs and holders, crocodile clips, razor blade, nails, coins, office pins, chewing sticks, broom stick, a match and match sticks.

Step I: Lighting of a torch

The following activities could be carried out by the teacher while the pupil observe and discuss their observation on each:

i. A torch is switched on without any battery in it.
ii. A torch is switched on with one battery though it has a capacity for two.
iii. A torch is switched on with two batteries with wrongly arranged terminals.
iv. A torch is not switched on though it has two batteries properly fixed.
v. A torch with batteries properly arranged is switched on.

The pupils should be guided to identify the things involved in the lighting of the torch. They should also be guided to carry out demonstrations themselves.

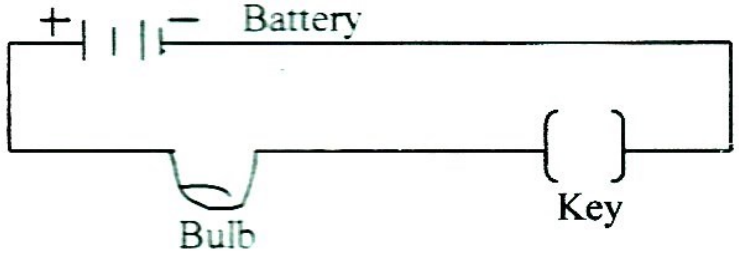
Step 2: Using a Circuit Board

Guide the pupils to discover the similarity and differences existing between the torch and the circuit board. Using the circuit board guide the pupils to make the following connections, observing and noting what happens to the bulb in each case:

i. Using one battery with one bulb
ii. Using two battery with one bulb
iii. Using one battery with two bulbs
iv. Connecting different materials in the circuit and noting in which the bulb lights. Separating the materials through which current can pass through from those currents cannot pass through.
v. Connecting two bulbs in series and then in parallel using one and then two batteries respectively.

Step 3: Drawing a simple electric circuit guide

Guide the pupils to draw a simple circuit as shown below:



CONCLUSION

It is obvious from our workshop that teaching primary science in a primary way requires a lot from both teachers and pupils. The materials must be provided and the pupils must be guided to use them. This underscores the need for science laboratories in primary schools.

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