



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

**A Book of Readings**

**DR. (MRS.) COMFORT EKPO**  
Editor

A Publication of the Institute of Education, University of Uyo, Uyo, Akwa Ibom State.



# **RESOURCE MATERIALS AND STRATEGIES FOR EFFECTIVE TEACHING OF SCIENCE, TECHNOLOGY AND MATHEMATICS**

**COMFORT M. EKPO**

## **INTRODUCTION**

An understanding of the contents of science, technology and mathematics is a gateway to technological development. There is no magic about economic and technological advancement; appropriate education is the answer. For almost two decades Nigerian educators have been experimenting with educational systems to settle for the most appropriate system. It is expedient to evolve strategies and instructional models that can promote the understanding of science, technology and mathematics (STM) if meaningful development must take place in Nigeria.

## **THE NATURE OF SCIENCE, TECHNOLOGY AND MATHEMATICS**

Simply defined, science is the orderly study of facts about things and creation using our sensory organs. It also refers to the systematized knowledge produced by careful observations, measurements and experiments which attempt to establish general laws or principles for describing the phenomena under study. (Page & Thomas, 1979) Technology on the other hand has to do with the creative application of a branch of science in industrial or in other practical situations while mathematics is the science of magnitude and number. An understanding of the contents of science therefore will aid in the proper application of scientific theories on problem situation. The search for a fuller understanding of the phenomena about us which is the process of scientific investigation is pursued by scientists the world over. Just as science itself is universal, the quest for improved methods of teaching science is equally universal. The use of common and widely available resources and materials in science teaching is also universally acknowledged as progressive. If science is to be learned effectively, it must be experienced. Science is so closed to the life of every learner that no teacher need teach it without first-hand materials for better understanding.

Science, Technology and Mathematics are given prominence in the Nigerian National Policy on Education document especially at the foundation levels of the educational system. At the pre-primary level, education is aimed among other things at inculcating in the learner the spirit of enquiry and creativity



through the exploration of nature and the local environment (NPE, 1998 P.11). Teachers at this level are expected to teach the rudiments of numbers, colours, shapes, forms etc., using instructional games. At the primary level emphasis is expected to be on teaching methods that can de-emphasize the memorization and regurgitation of facts. It is expected to lay a sound foundation for scientific and reflective thinking. To realize these objectives, practical exploratory and experimental methods are to be heavily utilized. The secondary school graduates are expected to be a generation of people who can live effectively in this modern age of science and technology. That means they should be well equipped to utilize the known scientific knowledge. To this end, the core subjects are selected in a way to enable the graduates offer either arts or science at a higher level. Despite these provisions in the national policy, science, technology and mathematics are still dreaded by many youths especially the girls (Williams, 1987). Without proper articulation of scientific facts, the knowledge gained cannot be meaningfully applied to problem areas. The upliftment of human dignity requires developmental pattern, which can guarantee the individual adequate supply of his / her basic needs like food, shelter, healthcare and suitable clothing. A successful attainment of these is synonymous with technological breakthrough in instruction, and novelty which stimulates learning is equally introduced to the learning situation. The use of media resources add realism to mathematical symbols and ease the teaching of theoretical concepts in science.

### **INSTRUCTIONAL STRATEGIES THAT PROMOTE THE USE OF MEDIA RESOURCES IN THE HANDLING OF SCIENCE, TECHNOLOGY AND MATHEMATICS**

From the discussion so far, it means the most effective way of handling science, technology and mathematics is an approach that ensures learner's full participation with ample provision for the inculcation in them the spirit of enquiry and creativity. A teacher who encourages creativity strives to provide a classroom environment replete with media resources that capture learners imagination (Ekpo, 1994). Such a teacher cannot but employ newer instructional strategies that are both media and learner centered, namely:

- i. **Inquiry Method:** This helps learners to grow intellectually by developing their ability to ask questions, analyze information received and seek creative ways of solving problems. Inquiry method is an individualized learning approach for it lays greater emphasis on access to learning resources and instructional facilities. Learners employing this approach progress at their own pace and make faster progress than



learners taught by traditional or conventional methods. More importantly, such learners show increased interest in school, school work and peer teaching soon ensues.

**ii. The Demonstration Approach:** This can either be progressive or teacher centered in practice. Demonstration method when highly formal or teacher centered, involves an instructor imparting not only knowledge as with the lecture method but also skills, a concrete illustration of a skill in this manner is always better than mere talk about it. Yorke (1981) sees this method as serving two major purposes in instructional situation namely:

- a) It shows learners the correct use, and limitation of apparatus and equipment, and,
- b) It aids teachers in the teaching of theoretical concepts (perhaps in situations where there is insufficient or unsuitable equipment for the students to use personally).

When this method is well handled, it arouses a great deal of interest and attention in the learners, but if anything goes wrong in the course of the demonstration, the teachers can lose a great deal of face. Demonstration strategy could equally be peer – controlled.

**iii. The Community Study Approach:** Here, both teachers and learners can observe and have a first hand interaction with resource persons and things in the real world. Community study activities were erroneously thought of as incidental to the curriculum but they have been seen as an integral part of it, Wittch and Schuller, (1979). Two basic ways of utilizing the community resources with this approach are through the use of field trips, study trips or excursions and through the use of resource persons and guest speakers.

These three strategies do definitely put pressure on teachers to source for and select media resources for their teaching / learning events. This is as it should be. A progressive teaching strategy should exert pressure on teachers who are experienced, trained and committed.

**iv) Interactive Multi Media Approach:** This is a highly progressive instructional strategy which is gaining much ground in developed nations for individualized learning. The use of virtual reality (vr) has been seen as one of the newest multi media applications of computer – based technologies (Heinich et al 2002). VR is a computer-generated three dimensional environment where the learners are actively involved in their learning. The significant thing about this approach is the expansion of learning experiences for the learner. It provides the learners opportunity to interact uniquely with the simulated environment. Above all learning from the virtual reality ensures that the learners are exposed to a realistic



world without subjecting the viewers (the learners) to actual hazards of real community learning experiences.

## **IMPLICATION OF PREFERRED STRATEGY FOR MEDIA USE**

Instructional strategies may be described on a continuum from the extreme formal type where the teacher is solely in control, to the extreme informal where the learners are in control. The differences between these strategies, as Yorke (1981) observed, lie mainly in the nature of interaction between the teacher and the class of learners. The four progressive strategies hereby identified as appropriate for the handling of Science, Technology and Mathematics can hardly be effected without adequate supply of systematically designed media resources and, or, environmental resources (e.g. Community or industrial based resources).

For the purpose of deriving a pattern of media use by secondary school teachers in Nigeria, Ekpo (1990) sampled 430 teachers from 16 secondary schools in Akwa Ibom State and 4 federal government controlled colleges across the country. Media resources found to be in use were classified into five formats using Ellington (1988) and Romiszowski (1988) classified models.

These are:

- i. Graphic Materials which include maps, globes, charts, posters, flash cards and flat pictures;
- ii. Print Media, including text books, library books, journals, magazines, newspapers and work books;
- iii. Two and Three Dimensional Display Media, including mobiles, models artefacts, realia and diorama;
- iv. Still Projected Visuals and Audio Media, including slides, overhead transparencies, filmstrips, audio cards, audio tapes, compact disc and phonography records, radio programs;
- v. Multi-media Resources including instructional games, learning packages, films, videocassettes, and computer programs etc.

Generally the print and graphical media were the most commonly used media resources by most of the teachers across four subject areas namely: Science, Art, Social Sciences and Vocational / Technical. Specifically 116 Or 63.4% of the science teachers use charts and a substantial higher amount of journal and magazines. Generally a low percentage of science teachers use two and three dimensional materials in their teaching despite the fact that realia and models are closely associated with direct or concrete purposeful learning experiences which is very appropriate for the handling of sciences. Also, the science teachers tend to use a comparatively high percentage (28.4%) of learning packages than all other subject teachers in the study.



Similarly, findings from the 1986 International Report Commissioned by the international Council for Education Media (ICEM) revealed that Science, Mathematics and English Language in primary and secondary schools in Nigeria have got higher media integration than other subjects (Ogunbi, 1986). It is worth noting that any of the media resources in the five classified groups may be used for the teaching and learning of Science, technology and Mathematics. However, certain considerations must be borne in mind namely:

- i. The learners' characteristics and needs should be properly analyzed and addressed so that selected media may match their needs.
- ii. The central objective of the required instruction and supporting or enabling objectives should be clearly focused.
- iii. Expected responses from the learners at the end of their interaction with the chosen media resources should also be known in advance.
- iv. Specific media resources that can give the learners the needed learning experiences and skills can then be selected and used.

## CONCLUSION

The teaching of Science, Technology and Mathematics ought to be enhanced to ensure that knowledge gained can be effectively utilized in other problem situations. This paper centered on the need to utilize media resources during the teaching and learning of science, technology and mathematics to add realism to the abstract characteristics of these science related subjects. Some teachers have resorted to abstract symbols solely in the teaching of science, technology and mathematics with the excuse that there are no relevant media resources for their use. These are teachers who still feel that community study activities are incidental to the curricula whereas these are now seen as integral part of the curriculum. They lend themselves for instructional use for optimal benefits.

For the discussion so far it is obvious that any type of media (visual, audio or audio media, print or non-print) can be used in the handling of science, technology and mathematics. Media resources that lend themselves greatly to the teaching of science, technology and mathematics are not only the systematically designed resources; environmental and industrial based resources do provide inactive learning experiences as well. Learners can be trained to help the teachers identify all unrecognized community resources for instructional use. That in itself can be a worthwhile learning experience.

The guiding question should be what kinds of creative, innovative responses will learners be apt to make as they internalize and put to use the information gained through environmental resources or community study experiences? It is hoped that teachers will select progressive instructional strategies that will necessitate their use of media resources for effective handling of Science



Technology and Mathematics and will make definite effort to source for and select such materials for use.

## REFERENCES

- Ekpo, C. M. (1990) A Critical Evaluation of Instructional Strategies Using Media Resources In Nigerian Secondary Schools. A PhD Thesis Wales: University College Cardiff.
- Ekpo, C. M. (1994) Attitudes of Nigerian Secondary School Teachers Toward Media-Based Learning. An article produced on the First Micro-filche frame (1 of) in Resources in Education (RIE) May, 1994 Eric: Social Studies / Social Science Education Centre, Indiana University, U.S.A.
- Ellington, H. (1985) Producing teaching Materials: A handbook for Teachers and trainers. London: Kogan page Ltd.
- Federal Republic of Nigeria: (1998) National Policy and Education (3rd ed.) NERDC Lagos; Federal Government Press.
- Heinich, R; Molanda M.; Russell, J.; Smaldino S. (2002) Instructional Media and Technologies for Learning 7<sup>th</sup> ed. New Jersey: Merrill Prentice Hall.
- Ogunbi, B. (1986) "Nigeria: A shortened Version of a research study conducted under the auspices of the National Educational Technology Centre" in Tucker, R.N. (ed): The integration of media into the curriculum: An international Report commissioned by the international council for Education Media. London: Kogan page Pp 171 – 182.
- Page, T and Thomas, J. B. (1979) International Dictionary of Education, London: Kogan Page Ltd.
- Romizowski, A. J. (1988) The Selection and use of instructional media: For improved classroom teaching and for interactive, individualized instruction, 2nd ed. London: kogan Page.
- Schramm, W. (1977) Big Media, Little Media: Tools and Technologies for instruction, London: Sage Publication Inc.

- Williams, G.A. (1987) 'On promoting Female Participation in Science, Technology and Mathematics Education' (in) Education Today: A quarterly journal of the Federal Ministry of Education 1, (1), 9-19.
- Wittich, W. A. and Schuller, C.F. (1979): Instructional Technology: Its Nature and use 6th ed. New York: harper and Row Publishers
- Yorke, D. M. (1981): Patterns of Teaching: A Source book for Teachers in Future Education. London: Council for Educational Technology (CET).