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TEACHING STRATEGIES FOR NIGERIAN SECONDARY SCHOOLS

edited by

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Ch. 20 Modern Trends in Physics Teaching at the Secondary Schools Level.

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Introduction

Physics has suffered and is still suffering in the hands of teachers; it is unwelcome by most students over the years (Farombi, 1997) as measured by the enrolment pattern. Apart from the enrolment pattern, the students who found themselves offering the subject do not do well at the public examination like WASC (Salami, 1992). The reason could be that the teaching of physics seems so abstract that an average student hardly knows its difference from a mathematics class. Hence, the few students who survived the rote work cannot form any appreciable relationship between what they learn in the classroom and what they encounter in the physical world. In order to make the subject meaningful to students this chapter examines the modern trends in physics teaching at the secondary schools level. Specifically, various teaching strategies will be discussed.

There are some concepts, which are used interchangeably in teaching and learning processes; these are methods, strategies, techniques and approaches. Attempt is not made in this paper to differentiate between these concepts. However, strategies or methods of teaching are special techniques useful in affecting areas of students' behaviour. It is proper to state that it is possible for many strategies to be interwoven, and that more than one strategy could be used in a typical class. Some of the commonly used strategies or methods are the inquiry/discovery method, project method, expository teaching method, 3Rs (read-review-recite) method, mastery learning; advance organizer; individualized instruction. Others such as textual materials, problem solving, lecture, audio-visual and computer assisted instruction (CAI) will be discussed too.

None of these strategies can be called the best for teaching Physics at the secondary schools level. Nevertheless, our knowledge of these strategies will place us in a better position to manipulate them to achieve maximum

performance in the students' learning behaviour. It should be noticed that whatever strategy a teacher uses, his aim it to achieve a desired outcome (no matter how little) in learners.

Mastery Learning

This is a teaching strategy which can be used to bring almost all (say 90 percent) of the students up to high levels of proficiency in the materials being taught (Block, 1971). The weakness of this strategy is that it is limited to the area of cognitive and psychomotor domains while affective is not much catered for. We may consider this weakness as a strength because Physics has much to do with cognition and skills modification. However, we know that attitude (affective) in Physics is a determinant of students' achievement in Physics.

Condition for Mastery Learning

Timing: time in mastery learning is not rigid but flexible. For example, in a typical Physics class teaching, all students work on a particular topic for a stipulated time (say a period or two). At the end of that fixed period of time, it can be noticed that some have gained mastery and others have not at all while majority are in-between. In the scenario described, achievement is a variable and time is a constant. In mastery learning, this process is reversed, such that the achievement is held constant and we vary the time for almost all the students to get to mastery.

Feedback: one of the requirements of mastery learning is a carefully organized system for monitoring students' work and providing corrective feedback. When students are wrong, this should be pointed out as soon as possible and not later with clear suggestions on how to help correct the error. The corrective feedback prevents students from practicing errors and stamping them as correct information. It also keeps them progressing continually instead of wasting time when they come across obstacles in their learning.

In mastery learning, it is teacher's role to decide what level of performance constitutes mastery. He also provides ways to monitor the work of each student and provide immediate feedback when necessary. Teacher should also provide variation in the time allotment that students require in attaining mastery level. Teacher must device an adequate

system of recording students' performance and how far they have gone in learning since different students will be reaching mastery at different times and will be working on different tasks.

Let us consider this example,

> *A train accelerates uniformly 2m/s2 in 5s and attains a uniform velocity. It travels in uniform velocity for 10s and retarded after 5s. Using graph, what is the distance covered?*

You may discover that some of your students have not mastered how to plot graph, in addition they have not mastered how to determine the area under graph. You have identified two problem areas, then those of them who have these problems may be taught separately while engaging those that have mastered the two problem areas. After testing them, you discovered that all of them could do well in one of the 2 problem areas and few of them are still deficient in one of the two problem areas. It behoves the teacher to take them through that other problem area, so that mastery could be obtained. The students' roles include working on the assigned tasks and asking for help when they have difficulty. The strength of this method is that at least 90% of the students would have mastered the topic presented. One of the limitations of this method is that it is time consuming. Another one is that teacher requires a great deal of patience to identify the students who have attained mastery.

Advanced Organizer

The strategy formalized by David Ausubel (1960) entails giving a brief and clear preview of what is to be taught. It makes mention of the essential elements to be learnt in material and indicates how those elements relate to each other. This strategy assists learners in learning and remembering. Although advanced organization fits beautifully into expository method of teaching, it can also be useful in Physics. The most important thing about advanced organization is to answer the questions *what? why? which? how?* and *where?* For example, one of the difficult areas of Physics at the secondary school level is "heat". In advanced organization, a teacher provides answers to such questions as *what is the meaning of the question?, why is the problem so important?, which way do we go about solving it?, how can we make the question meaningful*

and understandable? where do we begin and where do we end solving of the question?

Individualized Instruction

Another name given to the individualized instruction is learning by doing. The proponent of learning by doing was an educator, philosopher and psychologist, John Dewey. This instruction hinges on the fact that *fingers are not equal*; hence we are not all the same (i.e. we do not learn at the same speed). We observed differences in the students we teach (individual differences) and try to help them by giving them individualized instruction. It is a teaching strategy that helps us to give attention to individual differences (i.e. differences in ability, interest, needs and preferred learning styles). It entails doing what you think best for each individual student. (Note that this does not always imply individual work). We do a lot of this unknowingly in the classroom. When we vary either the content, objectives, activities, or time for a particular student, we are using individualized instruction. For example, in mastery learning, we vary time; in modularized instruction, we vary activities – here students select activities they prefer from a variety of activities, all of which lead to the same objectives and so on.

Questioning

Socrates used questioning as a total teaching method, believing that immense knowledge lay unrealized within the mind of every person but by using skillfully designed questions, a teacher could bring to conscious awareness the knowledge that already lay fallow in the students' minds. Many people use questioning to test rather than to teach.

The use of questioning became one of the teaching strategy and was popularized by Norris Sanders (1966) who moved questioning from a testing function to a teaching function and showed how to use questioning, make students think at different cognitive levels, using Bloom's taxonomy of educational objectives. Some questions task students at the level of fact (knowledge), comprehension (understanding), applying, analyzing, synthesis and evaluating. Sander's work helped teachers remember to task students on higher cognitive processes like analysis, synthesis and the evaluation (the why's and how's) instead

of focusing on lower processes like knowledge or recall (the what's, when's and where's).

Question should spread out the materials being learned using the behavioural objectives. It may be used as advanced organizer. The questions should be presented in such a way that students have to respond to them before they can proceed. Teachers should learn to phrase questions correctly at first attempt. The second attempt may be necessary if there is evidence that students do not understand such questions. Teachers should wait for students to attempt the questions.

Textual Material

Availability and use of textbooks have consistently raised student achievement level in science (Heyneman and Loxley (1983). However, some of these texts are not well prepared: pictures diagrams and charts are lacking in some texts, the arrangement and grammatical structures of some texts are enough to discourage a learner from using such. Another factor is that most of these good texts are expensive.

Although this strategy is good for mature students, those in primary schools could use it in Physics. Usually, in a good textbook, a topic is treated through several examples; a student could follow through such examples and be able to solve some of the problems in the text. In addition, a topic could be treated in the class and students are told to answer questions on a certain page or pages of their Physics textbook. Again, students in the same class may use the textbook on Physics together on their own without teacher asking them to. For example, two or more students may interact with each other and assist each other solve a particular problem in the text thereby increasing their chance of performing well in Physics class or examination.

Problem-solving

This is an investigative approach whereby learners are given tasks or problems to solve. The technique requires students to adopt a variety of skills to acquire the result. In a Physics class, a teacher presents a problem to the whole class. The problem may be modularized and each of the units assigned to individual or group of students. Consider a problem of determining the area of the classroom. This problem can be

divided into 5 units. One group could be asked to determine the length of the classroom with the use of metre rule or ruler. The second group could be asked to determine the breath. The 3rd group could supply the formula, the forth group could carry out the computation and the fifth group could supply the unit. Each group is given time to report their findings to the class; of course, the teacher is available to give necessary direction and guidance. This strategy serves as motivation for the students and promotes reflective thinking. It helps students to present their ideas in a systematic, logical manner. Students are encouraged to use both their hands and brain in the strategy and they become independent in study and reasoning.

Discovery Method

Here, students are allowed to discover facts for themselves in a logical and systematic manner. There are two types of discovery method: *the guided inquiry* method and *unguided inquiry* method. The guided inquiry method involves the teacher' guidelines, while the unguided allows students' free choice of investigation. The teacher could be a facilitator, a helper and a guide. This seemingly good (because it can be regarded as one of the learner centred) method, has the limitations that it is time consuming, difficult to manage and has unpredictable learning outcomes (Abdullahi 1982). However, the following are some of the merits: It allows students to gain knowledge on their own through active participation. It develops students' manipulative skills through personal contact with materials and apparatus. It encourages analytical thought. It promotes in students intuitive development and scientific attitude.

Audio-Visual

Audio-visuals have been identified as motivating resources for studies in the developing countries such as Nigeria (Lewis 1972). Audio-visual aids had been found to be helpful in assisting learners in concept building as well as in reducing the cognitive load (Mousari, et al., 1995). Iroegbu (1991) also discovered that audio-visuals are capable of helping learners to learn and acquire new concepts, assist in motivating them to perform like experts, help in constructing cognitive bridges and consequently capable of promoting the achievement of higher order objectives such as problem solving. This is a programme pre-recorded and shown to

students. The purpose of this approach is to break the monopoly of a human being, so to say, standing in front of the students. The advantage of the method is that students are fascinated to watch pictures on a screen and it arouses their interest and gives them a long attention span. The weakness of this approach lies on the fact that corrective feedback is not available. Another weakness is related to the question - how many of our schools can afford these audio-visuals? Or better still how many of the students have audio-visuals at home. Farombi's (1998) study revealed that not a single school surveyed possessed an overhead projector or television set much less a video player. Students also were allowed to report freely on whether they possess television and video player at home. Only few of them indicated that their parents could afford such; hence, audio-visual is limited in its use as a teaching method.

Computer Assisted Instruction

Much has been reported about the use of computer in the teaching and learning of physics concepts. Adesoji (1996) is of the opinion that the computer has been effective in stimulating students' interest and giving individualized tuition at the child's own pace and direction. There are two basic approaches of computer-based instruction. The computer managed instruction (CMI) and computer assisted instruction (CAI). Adesoji (1996) describes CMI as an approach in which the computer is used to perform the teacher's educational management functions. He describes the CAI as an automated instruction in which the computer is used to deliver instruction to the learner through interactive process. Macaulay (1993) identifies some of the ways the computer can be effectively used in the instructional system as follows:

- it can serve as a tutor, teaching new concepts.
- it can complement traditional instruction by reinforcing or expanding skills and knowledge.
- it can be used to automate some simple level of instruction (drill and practice) or present specific topic in any subject.
- it can be used by the teacher to review skills already taught.

Abimbade (1997) states that computer based instruction has certain unique characteristics, which include the following: learner controlled, self pacing, prompt feedback, random access facilities, adaptability, flexibility, adjustability, facilities for revision, and so on. Thus, in the process of instruction, the computer assesses the learner's initial competence, diagnoses difficulties and uses this to determine what he should engage in. The instruction progresses on the basics of what each learner achieves at each stage, the set of criteria of competence and available alternative instructional materials that can be presented.

Effectiveness of computer-based instruction has been attested to by many researchers (Papert, 1993; Clark, 1984; Okebukola, 1990; Jegede, et al, 1992; Macaulay, 1993). Hence, many Nigerian educators have advocated for the introduction and effective implementation of computer education in Nigerian schools (Robinson, 1981; Okebukola, 1990; Madu, 1990; Galadima, 1990; Abimbade and Udousoro, 1997).

This method of teaching (i.e. the use of computer) has a promising result in that students exposed to the method consistently performed better than those exposed to the conventional method. However, computer has some limitations its cost is high; it demands a lot of time to master its uses; and an average Nigerian student still considers a computer as one of the "magic of the whites". This makes computer unpopular in the teaching and learning of any school subject.

Lecture Method

The most common method of teaching in our secondary schools is the lecture (monologue) method. In this case the teacher passes on some useful information to the learners without giving the learners adequate opportunity to react to the stimuli provided (Iroegbu, 1999). Hence, the use of lecture method has some limitations because achievement of learning objectives is lowered. This has prompted Lewis (1972), Joyce and Well (1980) to criticize the use of lecture method in our schools.

The approach focuses on a large audience, it involves the use of chalk to work some mathematical problem and explanation coming from the teacher. Another name for this approach is the chalk and talk approach. This approach is not popular in a typical mathematics class because

students will be involved in one way or the other. Responses from students make the approach less of teacher-centred. Again the use of charts concrete objects like globe, shapes like rectangle, triangle, square, cone, pyramid, etc., makes the lesson more interesting.

Discussion Method

Different students come to the class with varying views about any issue. When questions about an opinion are asked, students are bound to express their point of view on such issue. Their view may be convergent or divergent. In that situation, it is the responsibility of the teacher to act and serve as a moderator. There is a two-way communication between the teacher and the students. The teacher should not dictate or influence students' viewpoints. However, he should use questions which could make them reason than recall. Some of the merits of discussion method include the following: it develops positive interpersonal relationship between teacher and students and between students themselves. In addition, it promotes fluency in students as they interact in verbal communication. It also increases students' confidence in themselves and in the task assigned them. Notwithstanding, a limitation of the method is that it wastes a lot of time if not well coordinated because of students' incessant questions (some could be irrelevant). The method may lead to boredom, especially if the topic is not stimulating enough.

Laboratory Method

A laboratory method involves an activity carried out by an individual or a group of individuals for the purpose of making observations of processes and products of the activities. The method could be used to verify a scientific principle, law or theory already known by students. The practices of cognitive skills like *observation, classification, measurement and interpretation* of data could be enhanced. It can also be used to obtain scientific knowledge. Two approaches in laboratory method include laboratory exercises and experiments. The laboratory exercise consists of several activities carried out to provide practice in the processes of science in terms of designing and interpreting experiments, while the experiments are used for the testing of hypothetical statements, confirming the known and discovering the unknown.

This method has the following merits:

- It promotes critical thinking and understanding of scientific concepts, principles and facts.
- It develops favourable scientific attitudes in students through problem-solving approach.
- It develops attention and retention of information.
- It develops students' mental processes like observing, classifying, measuring, interpreting data, stating and testing hypotheses.
- It develops students' ability to observe and write reports on laboratory exercise.

The limitation of laboratory method is that the method requires more time and materials for investigation.

Conclusion

Attempt was made to expose the possible teaching methods for physics teaching at the secondary school level. However, the search for teaching methods which could be used at any given time has not produced any teaching method which could be termed the *best* (Iroegbu, 1999). This fact was once noticed by Langford (1987), hen he states that:

> *There is no single prescription as to how best to learn a given cognitive skill, students may benefit from exploration, discovery, hands-on experience or from being told, from a demonstration or tightly sequenced programme to develop specific skills.*

There is, therefore, no specific method we are suggesting in this chapter, but the following factors could be used in deciding which method to use.

- ✓ The previous knowledge of the students on the concept to be taught and their ability. When the class is a mixture of abilities (i.e. high, middle and low), different teaching approaches should be used so that none of these groups of students is disadvantaged in any classroom teaching situation.
- ✓ Efficiency in handling methods. Some teachers are more vast in one method than others. Therefore, a teacher should employ the method he can handle very well.

- ✓ How suitable is the method to the topic under discussion? For example, using textual materials to teach the effect of magnetic force on some iron fillings will not be as appropriate a method as laboratory method.
- ✓ The class size, if the class is large, discussion or demonstration methods will not be effective. Such methods as lecture with a lot of questioning will be effective in teaching large classes. However, methods like demonstration, discussion, and laboratory approaches will be effective for small classes.
- ✓ Availability of instructional materials. We cannot be talking of demonstration or laboratory method if there are no instructional materials, however, lecture method could be effective when there are no instructional materials.

According to Abdullahi, (1982), teachers should vary their method of teaching as often as possible.

References

Abdullahi, A. (1982) *Science Teaching in Nigeria*. Ilorin: Atoto Press Ltd.

Abimbade, A. and Udousoro, U. J. (1997) The place of computer assisted instructions in mathematics education, in Olanrewaju, A.(ed.) *40th Annual Proceeding of STAN* pp. 238-243.

Adesoji, A. F. (1996). The need for computer-assisted problem solving instruction in Nigerian secondary schools. *Nigeria Journal of Computer Literacy* 1 (1) pp23-30.

Clark, R. E. (1984) Learning from computer: Theoretical problems. paper presented at Amer. Education Research Association New Orleans.

Farombi, J. G. (1997) Improvising techniques in experimental Physics for Nigerian schools: A compound microscope. *Proceedings of Ajumogobia Memorial Conference of STAN.*

Farombi, J. G. (1998) Resource Concentration, Management and Utilization as Correlates of Students Learning Outcomes: A Study in School Quality in Oyo State. Unpublished Ph. D. thesis, Univ. of Ibadan.

Galadima, M. I. (1990) Computer Education in Nigeria secondary school: Problem and Prospect. *STAN Conference Proceeding* pp. 60-63.

Heyneman, S. and Loxley, W. (1983) The effect of primary school quality on achievement across 29 high and low income countries. *American Journal of Sociology.* 88 (6) pp1162-1194.

Iroegbu, O. (1998) Problem – Based Learning, Numerical Ability and Gender as Determinants of Achievement, Problem – Solving and Line Graphing Skills in Senior Secondary Physics. Unpublished Ph.D. Thesis U.I.

Jegede, O..J., Okebukola, P. A. and Ajewole, G. (1992) Students' attitude to use of computer for learning, and achievement in Biological concepts. *Journal of STAN.* 27 (2) pp 61-65.

Joyce, B. and Weil, M. (1980) *Models of Teaching.* London Prentice-Hall International Inc.

Langford, P. (1987) *Concept Development In The Secondary School.* Beckenham, Kent: Croom Helm Ltd.

Lewis, J. L. (1972) *Teaching School Physics. A UNESCO Source Book.* Middlesex, England: Penguin Books Ltd.

Macaulay, O. A. (1993) Computer: A tool for helping children with specific learning difficulties in mathematics. *Journal of Issues in Special Education* 1, (1).

Monsari, S. Y., Low,R. and Sweller, J. (1995) Cognitive Preferences among high and low Physics achievers in two Nigerian secondary schools. *African Jour. of Educational Research.* Vol. 1 (1) pp.106-116.

Okebukola, P. A (1990). Computer education in Nigerian schools for the '90s. *STAN Conference Proceeding.* pp 38-49.

Papert, S. (1993) *Mind storms: Children Computers, and Powerful Ideas,* New-York: Basic Books.

Robinson, L. C. (1981). Computer, *Encyclopedia American* 5 pp. 472-473.

Salami, S. A. (1992) Secondary Education Programme Under the New National Policy on Education. Paper Delivered at the WAEC Monthly Seminar on August 28th.