

EFFECTIVE METHODS OF TEACHING MATHEMATICS AS IT AFFECTS NIGERIAN SECONDARY SCHOOLS

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Abstract

The teaching of Mathematics in Nigerian secondary schools has attracted much debate in recent times. The impact of untrained teaching personnel and poor facilities has had unpleasant effect on the interest of students on the subject. This work examines practical methods of teaching mathematics effectively at this level of educational pursuit. Recommended are measures aimed at encouraging students' interest on the subject as well as producing citizens with good foundation in mathematical reasoning. These types of citizens are needed for national development of Nigeria.

Introduction

Teaching is the process of leading learner through sequential statements and restatements of a problem. It is the body of knowledge that increases the abilities of the learners to grasp, transform, translate and transfer what he is learning or has learnt (Burner, 1998). Teaching is the passing on of ideas, knowledge, skills, attitudes, beliefs, challenges, and feelings to a person with the objective of bringing about a particular change in that person. (Balogun, 2002). Teaching involves the provision of experiences and guidance of the learning activities prepared to promote learning on those (students i to have new forms of behaviours and in specific forms upon specific occasions (De Young, 1999 and Skinner, 2002).

The Importance of Teaching

It has been shown that the various definitions of teaching conclude that teaching brings about a change in the learner. There is the need to look at the importance of teaching of mathematics by the teacher. Teaching mathematics involves some activities planned and executed by the teacher of mathematics who is expected to be experienced to induce into the learner specified series of learning behaviour.

The teacher is then regarded as an experienced person who has the knowledge of the subject matter to teach, knowledge of how to teach it and how to assess what has been taught to determine if his teaching is effective. He is a skilled and resourceful person who helps in change and builds morals of learners through the learning processes.

Teaching brings about organized learning, though learning can take place without teaching (Igwebuike and Ekwejunor-Etchie, 1993). The art of teaching does provide an enabling environment that is rich with learning activities for proper learning to take place. The learning environment must be void of noise and other negative factors for good learning to take place. In order to enable the learner carry out activities and learn through his own effort and experiences, the teacher should use discovery and inquiry methods of teaching.

Teaching creates opportunity for the learner to engage in activities that will enhance the learner to construct and reconstruct meaning to experience. The power to logical thinking and independence in ideas are gains of teaching. The process of teaching does create imagination, self-confidence, and sound moral character through experiential activities in the learners. The learning of mathematics in schools is very crucial due to the following reasons:

- (a) It trains the students' minds on accurate reasoning.
- (b) It helps students think or test facts to find out if they are correct.
- (c) It develops a healthy attitude towards learning in general.
- (d) It helps students recognize the place and importance of number in their own lives and the community in general.
- (e) It helps students to form clear ideas about relations of numbers and space.
- (f) It helps students develop sound foundations for the further studies of mathematical concepts.

- (g) It stimulates in students the interest and enjoyment of mathematics

- (h) It trains students in speed and accuracy in practical jobs.
- (i) It aids students in understanding the world as they seek to know about natural phenomena such as wind, rainfall, height, depths, distance, temperature. (FGN, 1998).

Personalities of The Teachers (As Applied to Mathematics Teachers)

The Mathematics teacher should be knowledgeable in the subject. He is a catalyst according to Havelock (2000), and a process helper who facilitates learning by providing an enriching learning environment, making students to investigate, question, challenge, experiment, critique, rationalize any matter of study. He should be able to encourage learners to carry out activities that generate experiences needed for learning to occur.

Mathematics teachers are looked upon as resources linkers when they link learners with all resources both human and non-human that can provide the necessary experiences.

The Mathematics Teacher Must Be a Diagnostician: He carries out diagnoses to determine the learners' needs, interests, dispositions; their abilities, and ways of assisting them to develop their learning rate. Ausubel (1998) opines that the greatest factor in Teaming is what the learner already knows, and the teacher's work is to determine this and teach him accordingly.

Ridgway (1996) suggests some vitals components of the teacher's work. These include:

- i. A firm grasp of general principles, relating to successful teaching and learning;
- ii. The ability to organize and manage the teaching and learning environments knowing how to implement, facilitate the instructional plan, and integrate the various components of this environment in order to bring about learning.
- iii. A lively appreciation of the educational implications of the relationships between school, home backgrounds of the students, their living environment and ability to interact effectively with students, parents and guardians.
- iv. The preparedness of a teacher to remain a life-long learner. He should try to develop professionally; knowing each student by name and not forgetting. Serving as a special help to students who need and want him.
- v. The knowledge of the subject matter (good knowledge of what to teach). The skills, attitude, values, appreciation of the learners, guiding innovating (developing curriculum and interpretation); finding new ways of doing his work better and not dependable; teaching to the learners' abilities; experimenting (researching into various methods of handling the problems, experiments on new theories and materials before teaching the students); acting as agents of change; providing creative thinking, model and evaluation.

Mathematics teacher as a motivator: Learning helps to solve problems. The teacher as initiator of learning motivates the learner by determining his needs, problems and ways of assisting him in meeting the needs. The mathematics teacher should be dully informed on how to arouse the learner's **interest** in tackling mathematics problems. The greatest motivational factor in learning is interest. Success can be achieved by the mathematics teacher when he uses some environmental realities to motivate the learner to learn mathematics speedily. The teacher can bring abstraction into concrete in class by using pictures, events (experimental); stones, pebbles and others to develop sources of motivation and love for the subject.

He must plan instruction well and ahead of time. He is a creative thinking model knowing what is expected to be done to the best of his (teacher's) ability at all times.

Qualities of a Good Mathematics Teacher

The Mathematics Teacher as a Model: He should not only disseminate subject matter or knowledge to the learners but also should lead them to divergent thinking processes and encourage creativity and independence.

The teacher should be able to determine the learner's needs professionally providing guiding services and models. He must be objective: accept constructive criticisms without prejudice(s).

He must know how to use different questioning techniques very effectively in classroom situations. Questions are not end themselves but instead are means to an end. Abimbade (1997) gives four reasons of using questions in teaching mathematics. These are:

- (i) to find out what the students know so as to prepare them for further instruction.
- (ii) to discover students' misconception and difficulties
- (iii) to encourage students' participation; and
- (iv) to test whether the objectives of the lesson have been attained.

He must be a disciplinarian and know how to manage classroom situation or other learning environments very effectively.

He must encourage cooperative attitude and group participation among students towards learning processes.

He must identify himself with the school, cooperate with his head-teacher or other teachers; showing interest in all school affairs.

Improving Teachers' Horizon and Professional Skill:

The mathematics teacher should continue to develop himself professionally to be current with new knowledge and development of the subject. He can do this by using current information from research about how to improve on his teaching. There are now better materials, and equipment that will facilitate and develop adequate mathematical concepts in students. Odogwu (2003) notes that continuous in-service training is needed for effective implementation of mathematics programme for the 21st century. According to Tunde (2000), the 21st century objectives of mathematics are broadened so as to attain a high level of creativity, positive attitudes, values and eagerness to learn. Ihebuzor (1986) also notes that effective teaching of mathematics cannot be realized except there are

- (i) a relaxed and friendly atmosphere a well
- (ii) disciplined classroom a well motivated group of
- (iii) learners
- (iv) high competence of the mathematics teachers, which can be developed through attendance of programmes such as seminars, conferences organized by institutions of learning, professional bodies, employers and consultants.

This developmental mode is called the non-formal setting, which creates opportunity for mathematicians to meet and discuss professional problems in a more relaxed atmosphere.

The formal professional development of the mathematics teacher is achieved through organization of teacher educational institutions such as colleges of education, colleges of technical education, polytechnics, and universities. Students are awarded Nigeria Certificate in Education (NCE); and degrees (B. Ed; B.SC(Ed) at the end of the programmes. Knowledge is not enough if we do not know how to pass it on to our students; and training is not enough if we have no knowledge to pass on to others. The competent teacher is a dynamic agent in facilitating learning process. Kneller (1993) opines that "the work of the teacher is to offer the knowledge (subject matter) and engage the learners in dialogue that will assist them to think for themselves and make knowledge personal".

Hence sound knowledge of subject matter by the mathematics teacher is a prerequisite for effective teaching. Evaluation is an essential component of pedagogy. The mathematics teacher has to: assess learner's entry behaviour to the lesson; diagnose learning difficulty among learners; assess the extent to which the aims and objectives are attained; assess the effectiveness of the integration of the various components of the learning experience (Igwebuike and Ekwejunor-Etchie, 1993). He uses his professional skills to prove his worth of teaching. The feedback collected by the teacher of mathematics enables him to decide whether he should revisit previous lessons or proceed further.

Problems or Pitfalls Affecting the Teaching of Mathematics

Mathematics which is the study of relationship between numbers, between spatial configuration, and abstract numbers has been taught poorly in Nigerian schools. The reasons for this poor teaching of mathematics in schools have been linked to implications of untrained personnel teaching mathematics.

A professional is a person connected with a job that needs special training or skill, especially one that needs a high level of education. There is the need that the teacher is trained or skillful in the field of mathematics for him to teach mathematics in school effectively not mere having knowledge of it like the Engineers, Business Administrator, Accountant etc, who are allowed to teach mathematics today in secondary schools. This trend has affected negatively the imparting of mathematics skills to the students. The result is that students today do not have enough foundational knowledge of mathematics.

The consequence of the usage of allied professionals in teaching mathematics has thus resulted in: " Reduction in mathematics standard in Nigeria compared with the international standards elsewhere.

- Discouraging students from studying mathematics in the higher institutions of learning such as Colleges of Education and Universities.

- Attendant negative impact on Nigeria's technological developmental advancement.
- Hampering effective application of mathematics in daily activities. It has been shown that about 65% of our secondary school graduates cannot express themselves in mathematical concepts and theories (Iyamu and Aduwa-Ogiegbaen, 2004).
- Failure to cover the scheme of work in mathematics. The academic scheme of work and curriculum of the subject are often not fully covered by the untrained teacher. He will only focus on the area of interest best known to him. The students thus are ill-prepared and ill-equipped in terms of scholastic attainment, inquiry skills, problem-solving, self-learning, environmental awareness, knowledge and application of mathematical information (Aman, 200 IjTunde, 1999).

Poor Teaching Methods

The teacher who is to teach mathematics should be a professional. The teacher is one who is professionally trained in the systematic art and science of facilitating learning by functioning as manager, administrator, guidance counsellor, and mediator in the school setting. He has also been described as one who inspires another to learn according to the subject requirement of the curriculum (Iyamu, 2002). For the mathematics teacher to be able to inspire students to learn, such a teacher must be well trained in pedagogy and subjects matter; well remunerated, guaranteed of respect and recognition; work in environment that generates pride and dignity, enjoy retraining opportunities, etc; Azuka (2001) has suggested that "if Nigerian school teachers are expected to inspire students to learn using adequate method, and become creative, develop abilities to think critically and independently, there is need for teachers who are happy, proud to belong, full of dignity and working in a good environment, for all of these promote their facilities and dispositions to inspire students to learn". The concept of methods in the teaching of mathematics is very important. This has to do with the two broad patterns of thinking approaches that form path of predetermined objectives of the topic. They • are Discovery and Expository methods of teaching mathematics.

Discovery Method of Teaching Mathematics:

Discovery occurs when an individual actively uses his mental processes to discover some concept or principle. Burner (1998), an advocate of this method, believes that engaging students in discussions in which questions, clues, and concrete material are used in ways to provoke their curiosity and attention; they can be encouraged to discover ideas for themselves. Burner claims that learning depends on:

- (i) The structure of the concept to be learnt.
- (ii) The nature of the learners' intuition.
- (iii) The desire of the learners to learn.
- (iv) The readiness for learning (Biological Readiness).

Any concept in mathematics can be taught effectively in an honest form to any student if it is introduced at the student's language level.

In planning a discovery lesson, the teacher should outline series of questions, problems or laboratory exercise; prepare to stimulate the thinking of the students, through systematic and sequential presentation of the questions. The weaknesses of discovery method, according to Awotu-Efebo (2001), include:

- (i) Teacher's time is consumed in guiding students.
- (ii) The slow learners and under achievers are not encouraged.
- (iii) Spirit of cooperation amongst students is discouraged.
- (iv) It requires proper organization and supervision by teacher.
- (v) Requires a lot of planning before it is implemented in class.
- (vi) It is difficult to develop creative thinking.
- (vii) Student's discovery may differ from that which the teacher had in mind in the objectives.
- (viii) Students who do not have self-drive may lag behind others.
- (ix) Demands a lot of responsibilities from mathematics students.

Types of Discovery Methods in Mathematics

- **Target Task Method:** This is the process of teaching some concepts first giving students difficult problem referred to as target task to solve. The target task problem may require the application of rule, principle or formula which the students have or have not known after giving hints or clues (Polya, 1999).
- * **Delayed Formalization Method:** The lesson begins by giving a mathematical expression and encouraging students to generate all possible equivalent forms of the expression (Polya, 1999). This is done to encourage the students to think divergently first before narrowing down their thinking to an appropriate conclusion. For example, given students $x/a - y/b - 1$, make b the

subject of the equation. The mathematics teacher provides the students with the necessary steps required to arrive at a valid conclusion. The students are free to generalize the rule or principle being taught at any point avoiding the use of technical terms. Hints are given as: The term in b i.e. y/b is already in a free state since the power of b is one.

Multiply through by the LCM of the denominators is ab ;

$$bx - ay = ab$$

collect like terms $bx - ab = ay$

factorize b out $b(x - a) = ay$

make b subject $b = ay/x - a$

The teacher summarises the lesson using technical terms and mentioning salient points, and the students are evaluated accordingly.

- **Heuristic "I find" Method:** Students are discovering here and not just passive recipient of knowledge. The mathematics teacher leads the students to select path to learning and chooses every step to express the lesson's objective, notifies students on their errors, correct mistakes. The students follow the mathematics teacher to formulate their own definitions, and the teacher helps the students by questioning and starting the solution to the problem (Ukpebor, 2003). For example, building a box with different dimensions of 10cm, 8cm, and 6cm respectively. The mathematics teacher breaks down the work into simple steps, well within the students' power. He ensures that the students carry out the steps successfully. The mathematics teacher can help the students with hints, use of questions, outlining a line of attack, and by starting a solution. This makes students to overcome their surrounding circumstances, and engage in meaningful learning. The hints for the example above are:

Measure the given dimensions; join the measurements to form a box with the longest side 10cm, base 8cm, and width 6cm respectively.

- **Laboratory Method:** This is the method of using relevant tools for teaching and learning mathematics in a practical manner (Polya. 1999). This may involve performing an experiment, viewing a film, playing a game, discussing, reading, programming a computer, building a model, solving a problem, making a survey, drawing a design, making a graph, presenting a mathematical skills, completing a test, proving a theorem practically, and so on. For example, the value π (n) can be determined using a thread to measure circumference of a round flat object and its diameter and using the diameter length to divide the length of the circumference i.e. $n = \text{circumference} / \text{diameter}$. When the students measure the circumferences and diameters say, ten circular objects of different diameters correctly, they will obtain in each case when they divide each circumference with its corresponding diameter.

Expository Method of Teaching Mathematics

Expository method is also called Reception or Lecture method. Ausubel (1998), a proponent of this method, sees discovery method as appropriate and desirable for achieving certain objectives; such as ensuring meaningful associations for complex or abstract ideas in mathematics. It is unduly time consuming and unnecessary for most learning of the school. It may fit into the normal school programme with some difficulty.

In Expository method, the students are usually presented with content to be learnt in a systematic manner. For instance, a teacher might start by considering the formula for finding area of a rectangle. He gives the formula as length x breadth ($L \times B$). He then gives examples and class works for students to attempt. The teacher comes to the class fully armed with necessary information gathered from textbooks and starts to pour some out to the students. It can be applied to a large class. A lot of work can be covered within a short space of time. Teaching aids (material) may not be necessary in this method. Notes taking are encouraged which later help the students in secretarial duties, etc.

Recommendations and Conclusion

Teachers' and learners' roles should be defined in school curriculum.

Our school system must be organized to promote students' active involvement in their own learning. This enhances the practice of self-learning as emphasized by *National Policy on Education* (1998).

Professional Mathematics teachers having B. Ed or B.Sc. (Ed), N.C.E, from our Nigeria teacher training schools should be employed to teach mathematics[^]

Teaching must be done to build the learners' (students) interest and sustain it. Teaching of mathematics must be in dialogues not mere giving of notes, discouraging interest. Students should be made to discover things themselves leading to generalization of concepts taught. The school environment must encourage learning and needed materials should be available to enhance students' confidence and skill manipulations.

This paper further recommends ways for ensuring effective teaching of mathematics and redeeming the glory of the subject in our schools.

- * Classrooms should be made conducive for the use of this approach (Discovery) in teaching of mathematics.
- * Teacher training colleges and universities should re-introduce and re-examine their innovative teaching methodology.
- * Teachers of mathematics should undergo in-service training in order to update their teaching skills.
- * Regular term workshops and seminars should be organized for mathematics teachers based on new mathematics innovations in teaching.
- * Mathematics teachers should be motivated to become more creative in their jobs.
- * Mathematics laboratories should be established in schools in order to make mathematics really practical and increase interest of students. * Those employed to teach mathematics in schools must be professionally rooted in the subject; training in pedagogy and able to inspire students to learn.

The two broad categories of instruction namely, Expository and Discovery must be given the dominant roles in our schools (Balogun, 2002; Iyamu, 1998; and Mkpa, 1993). Studies show that the expository approach has dominated the teaching of Mathematics in Nigerian schools i.e. a situation in which the teacher takes absolute responsibility for generating and impacting knowledge. This paper therefore concludes that discovery method should be given a dominant role and used in our Nigerian schools in teaching any mathematical concept. This will enable the students participate fully in learning, discover and generate any mathematical concept on their own.

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