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# Effective Methodology in Teaching Mathematics: The Way Forward

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**Abstract**

*Mathematics is one of the subjects that has received a lot of complaints as a result of the ways or methods it is handled by mathematics teachers in teaching the subject at all levels of education (Primary, secondary and tertiary institutions). This research work discusses the methods and strategies that can be used by mathematics teachers to teach the subject in order to make it interesting and motivating in the field of education by removing negative feelings /attitudes in the students that the subject is difficult.*

**Key words:** Teaching, approach and method.

Teaching has been defined in different ways by different scholars. To some, it is an art of passing knowledge to learners. Others see it as the giving of knowledge or skill or training on how to do something. Still, many look at it as an informal or formal way of acquiring new facts or ideas (Onwuegbu, 1979). According to Far rant (1990) teaching is defined as a process whereby a group of children are gathered under a teacher who drills them in knowledge, skills and attitudes considered of importance to life to Saidu, S (2008) teaching is regarded as an activity in which a teacher, learners and instructional materials come in close contact with one another for the purpose of learning. However, scholars have accepted that even though there is no one acceptable definition of teaching, it is an attempt to change the behavior of individuals and aid the acquisition of skills, abilities, habits, and physical competencies, all necessary for functional living in a dynamic environment. Method on the other hand may define as an overall plan for the orderly presentation of content or learning materials a specified

group of learners. To Active dictionary, the method is the way of doing something. More complete but related to dictionary meaning is the one offered by the researcher "as ways that we use to teach material to our students. Our choice of methods depends on *what we want to teach* (content), *who we are teaching,* and the *level of competence expected.*

## Instructional Methods

Any instructional method a teacher uses has advantages and disadvantages. Often times, a particular teaching method will naturally flow into another, all within the same lesson, and excellent teachers have developed the skills to make the process seamless to the students. Which instructional method is "right" for a particular lesson depends on many things, and among them are the age and developmental level of the students, what the students already know, and what they need to know to succeed with the lesson, the subject-matter content, the objective of the lesson, the available people, time, space and material resources, and the physical setting. Another, more difficult problem is to select an instructional method that best fits one's particular teaching style and the lesson-situation. There is no one "right" method for teaching a particular lesson. The methods obviously, not all are appropriate for all levels and subject matter content areas. An instructional method comprises the principles and methods used for instruction. Commonly used teaching methods in mathematics may include problem solving method, lecture method, questioning method and discovering method or combinations of these.

## Teaching Methods for Mathematics

In teaching process both questions "What?" and "How?" should be targeted. Knowledge about suitable methods, which make learning more effective, is important. The choice of teaching method or methods to be used depends largely on the information or skill that is being taught, and it may also be influenced by the aptitude and enthusiasm of the students. It is important that teachers learn to use a variety of teaching methodologies in order to cater for the range of learning needs and requirements in mathematics that are present within most classroom environments. In this paper a variety of teaching methodologies in teaching mathematics will be explored and their various advantages and disadvantages outlined. The following prominent methods for effective instruction in mathematics include, Problem solving method, Lecture method, Questioning method, and Discovery method.

## Problem Solving Method

Problem solving is the most independent of learning methods used in teaching mathematics and which empowers the students to initiate their own learning. The teacher makes all decisions about the content of the questions and therefore the correct answers; however the role of arranging sequences that lead to the correct solutions are

placed in the hands of the learner (Moss ton & Ashworth, 2002). The teacher therefore must assume the role of the facilitator, and be prepared to provide students with feedback rather than solutions (Harrison & Blakemore, 1983). Positive reinforcement is a very important element of the problem solving process, as it will further promote students to provide their ideas, thus further developing individual motivation levels and personal confidence (Moss ton, 1966). This is a situation where the teacher presents a problem to the students to solve on their own. Onwuka (1981) in Sanda, (2009) noted that problem solving is a process whereby the students undertake the investigation of problem, issues and conditions and come out with conclusions and recommendations. The conclusions include probing, discovering, thinking, analyzing, inquiry and finding solutions to problems. According to Suleiman (2010) in (Fajemidagba and Suleiman, 2012) problem solving method is a process which begins with initial contact with a problem and ends when the obtained solution is reviewed in the light of the given information. For Obodo (2004) Problem solving approach comprises of identifying and choosing mathematical problems which grow out of the experiences of individual students. Mathematics teacher are encouraged to use this method in the class by asking the students to go and find out the probability of an event and bring the result to the class for discussion and make necessary correction.

**Advantages**
The problem solving in mathematics have many values some of which are stated by;
1. It encourages the students towards independent thinking.
2. It leads to in-depth understanding of the study materials.
3. It forces students to arrange and classify facts or data.
4. It inculcates in the students the habit of seeking logical answers or finding adequate patterns which solve the problem.
5. It encourages students to think for themselves.
6. It stimulates the learner in discovering the solutions to certain problems.
7. It encourages the learner to reason and pass judgments in order to arrive at a reasonable solution to his problem.

**Disadvantages**
The following are the disadvantages of problem solving in mathematics;
1. Inability to achieve the answers may result in a lack of motivation.
2. It can only be used with students who are already able to take responsibility for their own learning.
3. It can take up a lot of time, as "students must have time and a supportive environment in which to work out solutions" (Harrison & Blakemore, 1983).
4. The outcomes of the lesson may not be achieved if the teacher's preparation is not adequate.
5. It takes a great deal of teachers' efforts, preparation, time and imagination.

6.   It needs special classroom conditions to foster (freedom, resource, materials).
7.   Sequence of Problem Solving Method in Teaching Mathematics:

Okorie (1986) in Obodo (2004) outlined a problem solving sequence for which one can relate it to the teaching of mathematics are as follows:
1.   The students should first read the mathematical problem so as to understand its demands in a general way.
2.   The student should re read the problem more thoroughly so as to determine what he is required to learn.
3.   The students should carry out the required operations and perform the necessary calculations so as to get an answer.
4.   The student should check the reasonableness of the answer by seeing how it fits the conditions of the problem.

## Polya Problem Solving Model

| Stage | Components | Representative Questions |
|-------|-----------|--------------------------|
| 1 | Understanding the problem | Read the problem and identify the unknown |
| 2 | Devising a plan or making a plan | Do you need a diagram, restate the problem, make a representation. Do you use all the data, condition etc. |
| 3 | Carry out a plan | Carry out the plan, check each step. Are the step taken correct? |
| 4 | Looking back | Can your plan be proved correct? Check the solution obtained. Can you use the method for some other problem |

Adopted:   Fajemidagba & Suleiman (2012)

## Process of Using Problem Solving in Mathematics
A bag contains 6 red balls and 4 blue balls. One is drawn from the bag and replaced. Then a second one is drawn. What is the probability that:
(i) they are both blue,
(ii) one is blue and one red.

**Solution**

**Step 1**: Understanding the problem;
1. Let the students understand the meaning of the following; Probability, Sampling with and Sampling without replacement.
2. They should consider the following information. The bag contains 6red and 4blue balls, one is drawn and replaced, second one is drawn.
3. They are required to find out the probability that both are blue and that one is blue and one is red.
4. Let the students describe the problem in their own words.

**Step 2**: Devising a plan to solve the problem,
The problem involves sampling with replacement. The colour drawn second is independent of the color drawn first. Therefore, multiplication law has to be used in solving the problem.

**Step 3:** Carry out the plan,
There are 10 balls out of which 4 are blue, therefore, the probability of drawing a blue ball is $4/10 = 2/5$.
The colour drawn second is independent of the colour drawn first. Therefore, the probability that both are blue $= 2/5 \times 2/5 = 4/25$
The probability of drawing a red ball $= 6/10 = 3/5$. Therefore, the probability of drawing first a blue ball, then a red ball $= 2/5 \times 3/5 = 6/25$.
The probability of drawing first a red ball, then a blue one $= 3/5 \times 2/5 = 6/25$. These are mutually exclusive events. Thus;
the probability of drawing a red ball and a blue ball when the order does not matter $6/25 + 6/25 = 12/25$.

**Step 4:** Checking the result.
The students are advised to go through the calculations. Thus,
(i)   Pr both are blue $2/5 \times 2/5 = 4/25$.
(ii)   Pr of drawing a red ball $= 6/10$
(iii)  Pr of one red and one blue $= 3/15 \times 2/5 = 6/25$.

**Lecture Method**
         This is an approach where the mathematics teachers deliver his lecture while the students remain dormant or passive listeners. This approach is suitable for senior students. This method of teaching is by giving spoken explanations of the subject that is to be learned. Bligh defines lecturing as "more or less continuous exposition[s] by a speaker who wants the audience to learn something," and notes that its use is not restricted to the formal educational setting, but is used in arenas such as politics (speeches) and religion (sermons). To Bello (1981) lecture method is a process whereby the teacher would come to the class fully armed with a mass of facts probably

gathered from books and would start to pour out the facts, perhaps pausing at intervals to ask a few questions, or, if he liked, might leave the asking of such questions to the very end of his lecture. Students are either listening attentively to him or taking down some notes. Other educators referred to the lecture method as a teacher centred method because it is the teacher alone who invariably does most of the talking while the pupils remain passive for most of the period.   A lecture can be used to provide a broad-based overview or introduction of a topic, particularly where the educational goal is for the learner to acquire a background familiarity with the subject, as opposed to a working knowledge. Nearly 80% of all higher learning institutions in Nigeria since late 1970s reported using some form of the lecture method to teach students that is why their teachers are called lecturers. Although the usefulness of other teaching strategies is being widely examined today, the lecture still remains an important way to communicate information in the institutions of higher learning.

**Advantages**

The lecture method in mathematics has the following advantages;

1. Lecture method will allow the mathematics teacher to cover a lot of ground within a short time.
2. Lecture method lies in the fact that the mathematics teacher spends little on teaching aids and other equipment.
3. It encourages students to talk by active participation and contributions in the discussion.
4. In lecture method time and effort are encouraged especially in mathematics topics that cover very much.
5. It can be used to teach a very large class.
6. It encourages students to read widely since they cannot write down all that the teacher says, and therefore, would have gaps here and there in their notes which they would have to fill up through extra reading.

**Disadvantages**

The disadvantages of lecture method in mathematics are many. They are enumerated thus;

1. The method allows little or no room for student's participation and student's teacher interaction in the lesson.
2. In the lecture method some lecturers talk too fast for students to fellows, others talk in low tune for all in the class to hear, and some just chew their words, causing students to become bored and probably mentally fatigued.
3. It does not encourage active participation by the students.
4. The problem of grammatical expression may confuse the students, if ideas are not explained properly.
5. Principles Observed when using Lecture Method in Teaching Mathematics

6. To use lecture method in teaching mathematics make sure you have plenty of aids and gestures to illustrate the lesson for the sake of the average students.
7. Watch your speed while delivering a mathematics lecture, because if you speak too fast not all the class will follow your talk and if you speak too slowly the fast learners may become bored, and may find some thing else to do.
8. In lecturing mathematics you should know your subject matter very well and present the facts in a systematic and logical order so that students can follow your line of thinking.
9. Give room for students to ask questions at intervals all through the mathematics lecture. Ask questions yourself; do not assume the students understood all that you have said.
10. Emphasize on important points you want the students to note as you lecture mathematics.
11. Finally, avoid walking from one end of the classroom to the other while talking or talking while throwing up and catching a piece of chalk.

**Questioning Method**

Questioning method of teaching is always known to be effective methods due to its interactive nature. The questions are asked by the teacher with an intention to know what the student has learned from earlier discussions and it helps in deciding what should be taught further. This can be even vice-versa, students questioning the teachers to clarify the doubts that would enhance their understanding of the subject mathematics. The teacher should encourage this in a positive way so that the student's critical thinking is developed. Mathematics teacher can use this approach in teaching mathematics topic like, Lengths of arc of circles.

The following questions were posed:

-Draw circles of a given radii, 5cm, 7cm, 8.2cm, 10cm.

-Ask the students to draw in the different circles, say one with radius 5cm. different sectors containing angles 30, 60, 90, 120 and 180.Using protractor to measure out the angles.

**Advantages**

Questioning method in mathematics have many advantages some of which are stated by;

1. Questioning method have wide applicability to all types of methods of teaching mathematics;
2. They encourage critical thinking abilities.
3. They are useful in diagnosing the learning difficulties of students in mathematics.
4. They can be used effectively in catering for individual differences in mathematics class.

5.  It helps the student judge how adequate his responses are and also encourage him to think independently of the mathematics teacher.
6.  They lead the learner to the boundaries of his previous knowledge.

## Disadvantages
1.  The following are the disadvantages of questioning method in mathematics;
2.  Unstructured questions may lead to confusion on the part of the students.
3.  The language difficult level if not observed can lead to lack of interest.
4.  Time wasted in the construction of questions especially objectives.
5.  It discourages the weak students when they fail to respond to questions or either laughed at by their mate or is rebuked by the teacher.

### Discovery Method
Discovery method is a method of teaching where the students arrive at new knowledge as a result of their own observations. This approach of teaching offers an avenue whereby the students use existing and established rules or principles to discover things for themselves. In applying this method to teach mathematics teachers are to formulate the underlying structure and content of their lessons in a manner that will force students to discover the answers to a range of problems for themselves. The role of the teacher in this approach is to guide and facilitate student learning in order to allow student discovery as well as promote ongoing experimentation and participation. Mathematics teachers can use discovering approach in teaching mathematics topic like Expression and Factorization of Quadratic expression.

### Advantages
The following are the advantages of discovery method of teaching in mathematics;
1.  It develops mathematical skills in independent research,
2.  It encourages the acquisition of patience, cooperation, and decision making in mathematics.
3.  It inculcates attitude, value, skills and knowledge which enable the mathematics students to become thoughtful inquirers about their environment.
4.  It fosters student's participation in mathematics activities and stimulates action within and outside the mathematics class.
5.  It helps students in understanding processes, concepts and relationships in mathematics.
6.  It generates, critical and logical thinking about mathematical ideas, issues, problems and questions.
7.  It helps students become more interested in mathematics and remember knowledge they find out by themselves.
8.  It provides new insight into new areas in mathematics that are not taught very well.

**Disadvantages**

The discovery method in mathematics has many values some of which are stated by;

It consumes plenty of time. Mathematics teachers do not have all the time to use this approach in teaching mathematics always.

1. It needs a lot of instructional materials in mathematics to be effective and these materials may be very costly to produce or procure.
2. When mathematical problems are too difficult, the students become frustrated and therefore lose interest.
3. It requires proper organization and supervision; otherwise the students will arrive at solutions which are not original.
4. It requires careful planning, cooperation and full participation of every mathematics student otherwise students may be frustrated.
5. It demands a lot of responsibility from mathematics students.

**Conclusion**

Mathematics teachers should be free to use methods they considers suitable for their particular students under particular conditions. To be effective, the mathematics teacher must have a thorough understanding of a number of methods, their strengths, weaknesses and particular conditions under which they operate best. A number of different teaching methods can be used in the classroom setting. The method selected will depend on the learning objectives, the technological resources available, the overall course design and the instructor's training.

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