

TEACHING OUTSTANDING MATHEMATICS LESSONS : PROS AND CONS

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Abstract

Mathematics is a core subject in virtually all educational institutions. There has been growing concerns about the best way to teach Mathematics so that learners can benefit maximally. This paper examined the teaching of Mathematics in an outstanding way. First, it enumerates the requirements of a Mathematics teacher to be outstanding and progresses to how the outstanding Mathematics teacher should teach at each educational level. Paper also lists some factors that an outstanding Mathematics Teacher need to be cognizant of like Mathematics phobia: symptoms, consequences and exterminating the phobia in Learners. Other factors examined include the use of creativity in a Mathematics classroom, games amongst others. Paper concluded by enjoining Mathematics teachers to be outstanding, to make effort on their learner's mindset to be transformed into a growth mindset and that they should sell the love of Mathematics to their learners.

Key words: *Mathematics lessons ,Teaching, Outstanding Mathematics*

Introduction

Mathematics is one of the ancient sciences developed in time immemorial and it is an age-long name in our Schools. Abubakar (2016)) described Mathematics as a language for all disciplines, it is what everyone does everyday without realizing its effect. The competence gained in the study of Mathematics is widely used in all spheres of human life. Mathematics plays a key role in the shaping of how individuals deal with the various spheres of private, social and civil life (Anthony & Walshaw, 2009). This justifies the compulsion of the study of the subject by all students who go through basic and secondary education in most countries. Contrary to popular misguided myths, doing Mathematics does not require special intelligence. Mathematics is the branch of Science that deals with numbers. It is the study of the measurement, properties and relationships of quantities and set, using numbers and symbols. Mathematics is a ' doing ' subject (Macrea et al., 2011).

A teacher is a professional, trained to assist learners acquire relevant knowledge and skill , create an enabling environment for learning to take place and guides the learner to visionise the future. Hence, to teach Mathematics, the teacher only needs to be outstanding so as to teach outstanding Mathematics lessons. Teaching culminates to Learning. So, how are Teachers supposed to teach Mathematics for their lessons to be outstanding ? A Mathematics teacher is expected to be highly knowledgeable. For a teacher to teach either at the Primary or Secondary level, first, the guiding principle must not be forgotten or underrated.

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The guiding principle with respect to teaching Mathematics at the Primary level are:

- i. The inculcation of permanent literacy , numeracy and ability to communicate effectively;
- ii. Mould the character and develop sound attitude and morals in the child;
- iii. Develop in the child the ability to adapt to the child's changing environment and
- iv. Give the child opportunities for developing manipulative and scientific skills that will enable the child function effectively in the society (Federal Republic of Nigeria , 2013).
At the Junior Secondary level, as a Mathematics Teacher, the revised Mathematics Curriculum for Basic Education in Nigeria is focused on giving the learner the opportunity to :
 - i. Acquire Mathematical literacy necessary to function in an information age
 - ii. Cultivate the understanding and application of Mathematical skills and concepts necessary to thrive in the ever changing technological world
 - iii. Develop the essential element of problem solving , communication, reasoning and
 - iv. Understand the major ideas of Mathematics bearing in mind that the world has changed and is still changing since the first National Mathematics curriculum was developed in 1977 . At the Senior secondary level, the main objectives are:
 - i. Provide a solid foundation for everyday life of developing the ability of precision, logical and abstract thinking and
 - ii. Fostering the ability to be accurate in solving both Mathematical and real-life problems (Federal Republic of Nigeria, 2013).

With all these in mind and the essential Mathematics to be taken care of , it now behooves on the Mathematics teacher to do justice to the excellent teaching of Mathematics with the ultimate aim of the learners being fully equipped with the Mathematical skill needed and required at each of their educational pursuit. Hence, this paper sought to highlight the intricacies in teaching Mathematics as an Outstanding Teacher to Learners.

Requirements of an Outstanding Mathematics Teacher

An Outstanding Mathematics Teacher is required to be:

- i. Equipped to Teach

A Teacher should be fully equipped to Teach .The minimum Educational requirement for each academic level of teaching in Nigeria are the Nigerian certificate in Education (NCE) who are expected to be fully equipped to cater for Early Childhood, Primary till Junior Secondary School, First Degree BSc (Ed) or BA (Ed) holders are equipped to handle Senior Secondary School students while Masters degree MSc (Ed) holder should handle First degree students and Ph.D holders can handle Degree and Post graduate students.

- ii. A Professional

Professionalism in Mathematics implies being highly skilled and experienced. A Mathematics Teacher can acquire this by being a member of Mathematics associations both locally and internationally . Examples include Mathematical Association of Nigeria (MAN), Nigerian Mathematical Society (NMS) , Nigerian Statistics Association (NSA), Science Teachers Association of Nigeria (STAN)-Mathematics panel ,National Council of Teachers of Mathematics (NCTM), Women in Mathematics (WM)², American Mathematical Society

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(AMS), Canadian Mathematical Society (CMS) , Africa women in Mathematics AWMA , International Mathematics Union (IMU) etc. Here, the same language of Mathematics is being spoken in each of these associations, ideas are shared relating to the teaching and learning of Mathematics by Local and international Teachers, Conferences , workshops and seminars are organised by these Mathematical bodies all aimed at fostering the teaching and learning of Mathematics .

iii. A knowledge base

To be a Knowledge base, a Mathematics Teacher should have a library where all resource materials are kept like Books, e-books , internet link sites for Mathematics .The world is a global village and information abounds. There are lots of Mathematical sites where a Mathematics Teacher can update knowledge regularly especially in this 21st century with a click of the button for example Ask Dr Maths, Maths coach's corner, unique teaching resources, Teaching channel, Bedtime Mathematics , Maths Addicts etc, also affiliation with Mathematical centres like National Mathematical centre, Abuja, Nigeria , Atlantic Association for Research in Mathematical Sciences , Canadian Statistical Sciences Institutes is important , quality resource materials can be obtained therein as well etc .

All trainings and professional exposure is supposed to bring out the good quality of a Teacher which are to:

- i. Connect with students so as to find their ideas fascinating;
- ii. Help students think out loud;
- iii. Shinning examples of moral- no vulgar language please;
- iv. Need to explore students mind to be able to penetrate into their thoughts;
- v. Be able to understand the flaws in student's reasoning so as to be able to dislodge misconception and encourage them with correct perspective;
- vi. Break bully bound;
- vii. Sell the love of learning to students;
- viii. Practise differentiated instruction due to individual differences in the classroom;
- ix. Be gentle , firm and persuasive;
- x. Get learners to realise they need to visionise the future with their career in mind;
- xi. Personalise persuasive learning;
- xii. Simplify learning using non-cognitive skills through collaboration and improvise because there is a lot to realise from linking lessons to the real world (Practical Mathematics);
- xiii. Use instructional materials adequately and
- xiv. Using games.

Teaching Outstanding Mathematics at the Primary level

Primary level is the basis of education and has to be taken carefully and firmly .Primary Mathematics encompasses Arithmetics . Arithmetics is the branch of Mathematics which deals with numbers and the skills necessary to manipulate numbers which involves adding, multiplying, subtracting and division of numbers. In essence, Arithmetic facilitates the understanding of the structure of numbers (Abubakar, 2018). A number is a term used with different interpretation for counting and measuring. Under Progression of early numbers ,Pupils may know how to count but they might not really be able

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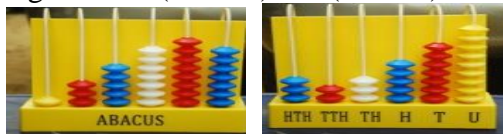
to relate the quantity of what is being counted. They have spatial pattern recognition. Hence subitising is one of the first task of a teacher. Making pupils to recognise quantity/ numbers without counting is termed subitising . Here, pupils can relate with 4 to mean 2 and more, visual subitising helps a lot . Then we graduate to Rote counting which brings the counting sequence . 0, 1,2,3,4,5,6,7,.. . . begins back and forth, the hierarchy of counting is deduced , here, they start to understand the nesting of numbers. It is important as Teachers to know how numbers are classified.

Examples are Natural numbers 1, 2, 3, 4, 5, . . . ; Whole numbers 0, 1, 2, 3, 4, 5, . . . ; Fractions $\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}, . . .$; Numbers in measuring include 45kg (weight), 5.6ft (height), 5ml (measurement of fluid), $30^{\circ}C$, $100^{\circ}F$ (measurement of weather conditions) etc. Mathematics is more of relevance to everyday day real –life and future career of the Learner. This is as it established in the guiding principle for Mathematics education .

An outstanding Mathematics Teacher need to understand that at the Primary level, Pupils: i.Can be excessively active (ii). Are always eager to learn , (iii.)Can be very inquisitive, easily agitated and can be easily confused and (iv.) Reacts positively to praise eg high five, great, good work, bravo etc (Abubakar, 2016). With all these in mind, the first job of an Outstanding primary Mathematics Teacher is Centuring. Centering is the first thing to do in a Primary classroom, this is the practise of focus . Pupils can be asked to sit up, close their eyes, take slow deep breath together etc. It starts every class in a focused point. This removes distraction like playing with each other or things in their hands.Next, the Concrete representational abstract **CRA** or Concrete pictorial abstract **CPA** sequence of instruction should be adopted. Jerome Bruner propounded that its quite simple , students must experience and interact with a concept to develop a true understanding. The 5C’s of the 21st century skills: Communication, Collaboration, Critical-thinking, Cross-cultural competence and Creativity fully equip an Outstanding Mathematics Teacher. A Primary Mathematics teacher should create effective brain breaks into their lessons to give children moments to calibrate and also keep in mind that most kids attention’s span are about as long as in minutes as their ages.

Primary Mathematics focuses on Numbers, Fractions, Money and Mensuration. Counting can be reinforced with the counting sticks. There is also the need to classify some numbers as friendly numbers e.g. 10, 20,30, 40,.. . Place value is an important concept in the addition and subtraction of numbers. Place value of a number identifies the position of the number within a given set of numbers. The abacus is a model based on place value to help identify the value of any numeral in a set of numbers. Pupils should be taught numbers in two stages:

- i. Recognising small single arrangement (perceptual) e.g. 1, 2, 3, 4,.. . and
- ii. Recognising the number shown by combining the single arrangements (conceptual)
e.g $45 = 40 (4 \text{ tens}) + 5 (5 \text{ ones})$



Examples ; What is the place value of highlighted numbers?

- a. 123.869 b. 317.538 c. 5187.248

Solution

Place value of 9 is $\frac{9}{1000}$ (Thousandths) , Place value of 3 is $\frac{3}{100}$ (Hundredths)

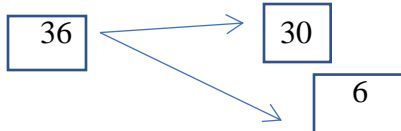
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Pupils should be able to image link ten frames and use it in Arithmetic

M	H/TH	T/TH	TH	H	T	U	Decimal point	Tenths	Hundredths	Thousandths	Tenthousandths
1000000	100000	10000	1000	100	10	1	•	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$\frac{1}{10000}$

iii.Composing and decomposing numbers



iv. Strategies for addition (+) and Subtraction (-)

a.Splitting

$$35 - 24 = (30 - 20) + (5 - 4) = 10 + 1 = 11 \text{ (Tens are combined and ones are combined)}$$

b.Friendly numbers

$$27 + 13 = (27 + 3) + (13-3) = 30 + 10 = 40$$

Adjust both added by adding or subtracting to make friendly number

v. Division (DMS loop- division, multiplication and subtraction loop)

$$\begin{array}{r}
 1145 \\
 5 \overline{) 5725} \\
 \underline{-5} \\
 07 \\
 \underline{-5} \\
 22 \\
 \underline{-20} \\
 25 \\
 \underline{-25} \\
 00
 \end{array}$$

$$5725 \div 5 = 1145$$

v. Fractions

One of the most easily confused set of numbers is the fraction. Fraction are rational numbers represented by the alphabet \mathbb{Q} from the Italian word Quoziente meaning number.

$$\mathbb{Q} = \left\{ \frac{x}{y} : x \in \mathbb{Z}, y \in \mathbb{N} \right\} \text{ where } \mathbb{Z} \text{ is the set of Integers, } \mathbb{N} \text{ is the set of Natural numbers}$$

In $\frac{x}{y}$, x is called the numerator, while y is called the denominator. Concepts interwoven with

Fractions are Highest common factor (HCF), Multiples, Least common multiples (LCM).

Practical examples of fraction abounds around

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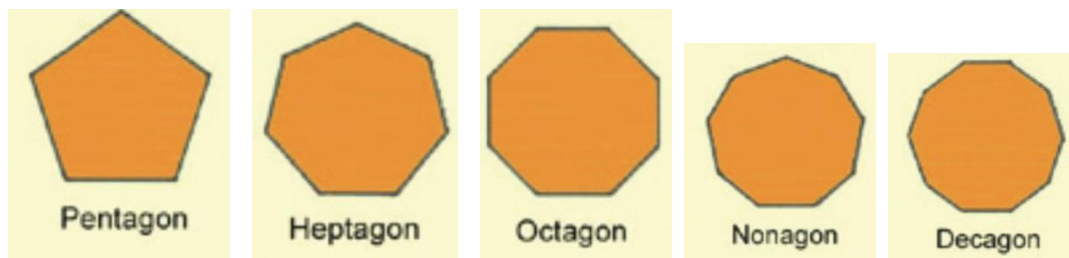


vi. Mensuration : 2 & 3-Dimensional shapes

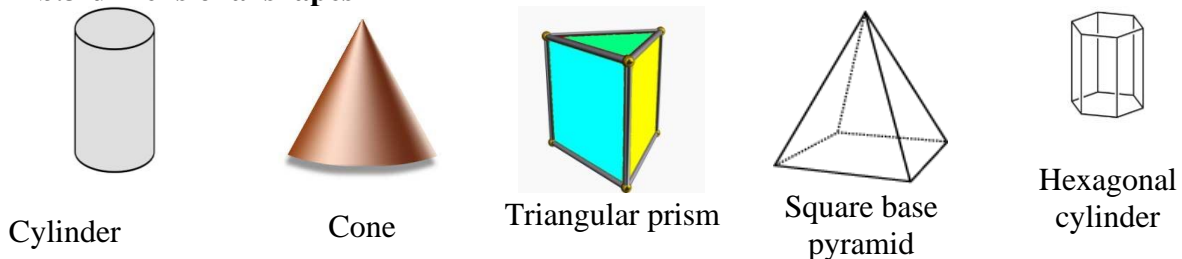
Shape is the external form or outline of anything. A polygon is a plane geometric shape consisting of a number of sides as line segments.

a.2- dimensional shapes are flat shapes.

Triangle (3 sides), Quadrilaterals(4 sides), Pentagon (5 sides), Hexagon(6 sides), Heptagon (7 sides), Octagon(8 sides), Nonagon (9 sides), Decagon (10 sides) Hendecagon(11 sides), Dodecagon (12 sides),Triskaidecagon (13 sides),Tetrakaidecagon (14 sides), Pentadecagon (15 sides).



b.3-dimensional shapes



Concepts with 3-dimensional shapes are surface area, capacity (volume). All these can be explained using the net form of 3-dimensional shapes, geoboard and shapes around the classroom.

- v. Financial Mathematics : This is the aspect of Mathematics that involves money , currencies, addition and subtraction of money,

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Teaching Outstanding Mathematics at the Secondary school level

Secondary level of Education is based on whatever has been established at the Primary level. At this level, Mathematics is more of relevance to everyday real –life and future career of the Learner. This is as its established in the guiding principle for Mathematics education . An outstanding Mathematics Teacher need to understand that Learners are most reluctant to learn. This is where Mathematics avoidance is greatest. The significance of Mathematics as we teach should be constantly reiterated. The concept of ‘selling the love of Mathematics’ to students is paramount and Instructional materials should be used excessively. Mathematics curricula at both the Junior and Senior Secondary is as contained in the Junior & Senior Secondary certificate examinations(JSCE & SSCE).Mathematics teacher needs to be abreast with this. Some things to take note of at being outstanding at secondary level include

a.Constant use of Instructional Material

It has been advocated that Teachers use Instructional materials excessively, Some instructional materials for some concepts are given below:

Place value- Abacus

Counting-Counting Sticks

Trigonometry , Geometry, bearing- Geotrigonometric sets

Longitude and latitude- Net globe

Fractions-Fraction Kits

Probability-Die, coin, playing card, tree diagram

Angles, Construction- Mathematical sets

Graph-Graph board, graph sheets

Sets- rope, different objects

Angle of elevation, depression- Inclinor

Geometry- Box of Geometric shapes (solid and net form), cardboard, shapes, Geoboard

Money/ Financial Mathematics/ Commercial Arithmetic- Financial charts, stock & Tax reports

Relations- Sociogram

Charts, Four-figure tables, tables, computer instructional aid/ materials, Calculator.

All these teaching/learning aids/materials should be in the Mathematics laboratory and workshop where students can conveniently go to feel these models, play with them and in essence, learn Mathematics

b. Mathematics Phobia

Mathematics is richly endowed and it involves and require a lot of time and patience, studying Mathematics takes time and energy. Some students feel they cant do Mathematics maybe due to peer view, societal , parental or surprisingly teacher’s view. These contributory factors create a feeling of doubt and fear to some learners even before they encounter the beautiful Mathematics. I repeat . everybody can do Mathematics. The unnecessary fear created bring about Mathematics anxiety (MA). Mathematics anxiety is an emotional issue involving self doubt and fear of failing Mathematics which is termed Mathematics Phobia. We have different types of phobia in the world like blutophia, acrophobia, somniphobia etc. Mathematics phobia is rampart in our Schools up to the extent that a baby can tell you I cant do Mathematics. Mathematics Phobia keeps growing everyday , gaining a global perspective to what Shaikh (2013) termed as global Mathematics

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Avoidance .Mathematics Avoidance nowadays is vast that a drastic action needs to be taken before we loose all our young vibrant Mathematicians to it.

Mathematics phobia is simply the fear to do Mathematics. Mathematics phobia has gradually transformed excessively into Mathematics avoidance . Mathematics avoidance is evident if a learner experiences a negative reactions to Mathematics situations, avoids Mathematics situation which leads to poor Mathematics preparation and evidently results to poor Mathematics performance.

Symptoms of Maths Phobia

- i.Emotional Symptoms -Feeling of helplessness , lack of confidence , fear of getting the wrong answer
- ii.Physical Symptons:- Heart racing, irregular breathing , sweatness, shakiness, biting of nails, feeling of hollowness in stomach, sometimes nausea.
- iii.Difficulty understanding , remembering concepts
- iv. Difficulty reconciling verbal / written cues
- v.Trouble with mental Mathematics
- vi.Mental mathematics , trouble analyzing time and recording analog clock
- vii.Struggling with motor sequencing that involves Mathematics

Consequences of Mathematics phobia

-Inability to concentrate, a blank mind (feeling of sickness when learners are confronted with a Mathematics activity), Low participation ,Low challenge tolerance, Falling behind other learners, Behaviour problem , Avoiding advanced Mathematics classes for success in many career after secondary school, Detrimental effect include nervous tension, fear of rejection and stress.

Exterminating Mathematics Phobia

- i. Acknowledge the phobia -First step is to acknowledge the existence of the fear in the learner
- ii. Dispel Mathematics Myths-Change fixed mindsets , carefully select our encouraging words
- iii. Try breathing exercises- Take a deep breath and give yourself the nerve to push ahead on the Mathematics activities
- iv. Create a love for Mathematics-Be evangelical which can inspire Mathematics, assimilation/ participation
- v. Encourage Mistake through encouraging risk taking, understand mistakes
- vi. Provide space and time for Mathematics. Mathematics comes with a speed limit , eschew treadmill learning, organize productive mathematics discussions;
- vii. Using several Mathematics teaching /learning strategies :Chunk, chew& check strategy ,ARRA strategy ,CRA etc
- viii. Games : Games can be relaxing especially recreational games
- ix. Make Mathematics visible : Mathematics is everywhere , lets nor rely on theory alone , we can go to a bank / supermarket under the topic of Money / Financial Mathematics or to a bridge to see how ellipse are used to suspend bridges etc.
- x. Formative feedback : At assessment level, feedback on how marks were obtained should be given, insisting on correction to ascertain mastery and correction of the mistake reduces negative impact

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of MA which can supercharge confidence, help to refine, revise ,practise retrying for the plan ahead.

- xi. Learners need to identify quality pieces of work and WAGOLL (what a good one looks like) (Dabell, 2017)
- xii. Peer effect/grouping -Get positive help from peers/ classmates
- xiii. Get help when needed, get organised, Grasp concepts deeply
- xiv. Practise , practise and practise Mathematicss on a daily basis
- xv. Apply Mathematics in real life situations
- xvi. Study smart , attend classes and continually test yourself
- xvii. Replace all negative self talk with positivity
- xviii. Utilize all resources at our disposal
- xix. Create a Mathematics confidence group/ Mathematics club/ Mathematics Laboratory where Learners can practise hands-on activities with Mathematics models/ kits
- xx. Take possession of Mathematics phobia: understanding that Mathematics phobia is an emotional sentiment that is whipped up and we accept hook ,line and sinker which should not be.
This should be at the back ground of any teacher that wants to teach Outstanding Mathematics Lesson. So, the hurdles to break as an outstanding Mathematics Teacher are :

- i. Penetrate into the minds of the learners
- ii. Boost their self-efficacy level (learners can study Mathematics)
- iii. Using gentle, firm but productive persuasion
- iv. Relate Mathematics to real time events
- v. Get learners to realise they need to visionise the future with their careers in mind which is interwoven with Mathematics
- vi. Practise differentiated instruction methods
- vii. Games , which makes Mathematics more relevant and engaging
- viii. Use instructional materials excessivel

c.Creativity in the Mathematics classroom

Solving problem is a Mathematician's way but problem solving itself is a creative process. Every Mathematics problem is an everyday activity. An outstanding Mathematics Teacher needs to be creative with Lesson presentation . Benefits of creativity in a Mathematics classroom include

- i. Arousing students' interest
- ii. Demonstrates Mathematics as imaginative and fun
- iii. Paints vivid picture of applicability of Mathematics in the real world
- iii. Creating highly innovative thinkers and this is the platform for positive mindset growth.

How to be creative in Mathematics classroom

- i. Convergent thinking characterised by determining patterns and breaking from established mindsets and divergent thinking
- ii. Evaluating unusual Mathematics ideas sensing what is missing from a problem
- iii. Splitting general problem into specific subproblems
- iv. Breaking away from established mindset

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- v . Overcoming fixations is necessary
- vi. Applying learner's strategies
- vii. Explore areas outside individuals known content-universe
- viii. Differentiate between creativity and systematic application
- ix. Reward students who seek to expand their content –universe
- x. Encourage high analytical skills

Conclusion

Outstanding Mathematics Teacher should make Mathematics instruction engaging so as to create a connection between mindset and learning, create an environment that make students feel comfortable with Mathematics instruction. Games can also be introduced, the quest to win the opponent actually makes calculation involved enjoyable. Mathematics is a 'doing' subject and should be kept at that. The mindset of pupils at the Primary level should be programmed at growth mindset that focuses more on effort and the belief that ability is not fixed, this will spur them to greater heights and Mathematics avoidance at the higher level will diminish. An outstanding Mathematics Teacher need to understand that Learners are most reluctant to learn. This is where Mathematics avoidance is greatest. The significance of Mathematics as we teach should be constantly reiterated. The concept of 'selling the love of Mathematics' to students is paramount. Instructional materials should be used excessively. Mathematics curricula at both the Junior and Senior Secondary is as contained in the Junior & Senior Secondary certificate examinations(JSCE & SSCE).Mathematics teacher needs to be abreast with this.

In essence, being outstanding as a Mathematics teacher basically requires for a Mathematics Teacher to be an embodiment of knowledge with all the skills attached. This sounds like a gigantic task but its not, it simply means we know what we are doing and we can do it very well. The internet is enriched with information but you should know what you are looking for before you activate it. Games can also be introduced, the quest to win the opponent actually makes calculation involved enjoyable. The mindset of students should be tailored to a growth mind set so that they can see the beauty in the learning of Mathematics.

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