Motivational Mechanics for Mathematics
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Sandhya Vasudeo Deshpande
Agarkar HighSchool for Girls,
Pune, Maharashtra 411011, India.

ABSTRACT

The aim of this article is to explain the Advance Programme designed for teaching pre-university mathematics to young students. The aim of the programme is to motivate students for doing mathematics and to allow bright students to learn at higher pace. The reasons for having such a programme and some results of having such a programme are also discussed in this article.

1. INTRODUCTION

The aim of this article is to explain the Advance Programme designed for teaching pre-university mathematics to young students. The motivation and aim behind starting such a programme is discussed in section 2. Currently, I am conducting a shorter mathematical training programme for advanced school students and its details appear in section 3. The results that I have obtained from this training programme are mentioned in section 5. Section 4 describes the main programme in detail.

2. MOTIVATION

Developing children's abilities for 'mathematisation' is the main goal of mathematics education. The aim of school mathematics is to develop useful capabilities related to numbers –numerals, measurements, decimals, percentages etc. It develops the child's resources to think and reason mathematically. To pursue assumptions to their logical conclusion and to handle abstract things. It includes doing things and the ability to formulate and solve problems.

The twin concerns of the mathematics curriculum are
  (i) what can mathematics education do to engage the mind of every student?
  (ii) how can it strengthen the students resources?

In the context of universalisation of education the first question to ask is what mathematics can be offered in 8 years of schooling that will stand every child in good stead rather than be a preparation for higher education alone? School mathematics plays a significant role in developing logical thinking, estimation, approximation and optimization. Visualization and representation are skills that mathematics can help to develop. Our students need to appreciate the fact that mathematics is an effective instrument in the study of science.

In our vision making mathematics a part of student's life experience is the best mathematics education possible. Several experienced teachers have expressed it from time to time that it is difficult to motivate good students because of the number of students in the class, and the same curriculum for all.
A curriculum disappoints both a talented minority as well as the non participating majority. Enthusiastic students get bored due to less challenging part. Hence I preferred to concentrate on special coaching mainly for enthusiastic and keenly interested students in mathematics.

3. BASIS OF THE PROGRAMME

At Pune in India, there is an institute 'Bhaskaracharya Pratishthan'. This institute provides opportunities for advance studies and research work in mathematics. I offered and operated my own programme 'ADVANCE MATHEMATICS PROGRAMME' for the students of the age 10 to 12 years. The result of the programme was very good. Students and my self all enjoyed it really. Results were extremely satisfactory. Presently I am offering and operating the same programme for interested students. It is also having good results. This is the basis of proposal out lined bellow.

In this programme we are completing – Commercial mathematics, Algebra, Geometry, Sequences and series, Set theory, Binomial theorem, Induction, Pigeon hole principle, Trigonometry etc. I noted that students usually respond very enthusiastically. There are no absentees and no one is quitting the course once joined. After completing each topic a practice sheet is given to them. Their difficulties in problem solving are discussed in the class. Then they have to appear for tutorial examination based on the same topic. Besides these tutorial examinations at the end of the year 100 marks examination is conducted. Students scoring 50% of the topper are admitted to the next year programme.

This programme helps them to achieve a top most position in almost all competitive examinations they are appearing. Not only related to mathematics but for all science related competitive examinations also. The power of reasoning and analyzing the situation is increased. Not only for mathematics but in day to day problems also. On the basis of this I thought to extend this programme in both the directions. The co-operation received from parents from time to time was real motivation for the development of this programme.

4. THE MAIN PRORAMME

We are referring this proposal as 'SPECIAL PROGRAMME FOR THE ADVANCE MATHEMATICS'. This programme considers to begin at the age of 4 years completed, when the respective capacities of the students are expected to be highest for any discipline and more so for mathematics. Students can join at any age that is suitable to them. Highly motivated students can complete the programme as early as possible. The other students can complete it in a period of 10 years.
The programme will be a proper channel to their curiosity, ability to learn new things, great energy etc. an aim of the programme is not only to score good marks but to give a proper channel to their exuberance. The programme is based on 10 examinations at an interval of 6 months each with successive examinations at higher levels of difficulty.

The details of the programme are as follows:
▪Name of the programme: SPECIAL PROGRAMME FOR THE ADVANCE MATHEMATICS.
▪Age limit: minimum 4 years completed.
▪Total 10 examinations – twice in a year.
▪Students who score at least 60% will be awarded <u>a certificate.</u> For each level best students will be honoured by medals and scholarships for their excellence.

A detailed curriculum for each examination is as follows:
AIMS:
- ❖ To motivate the students for mathematics.
- ❖ To give proper channel to student's enthusiasm.
- ❖ To make use of ability to learn new things.
- ❖ To explore their high energy.
- ❖ To calm hunger of knowledge.

EXAMINATION 1
AGE: 5 RUNNING.
1. Comparison of numbers:- bigger – smaller, more less etc.
2. Shapes:- point, line, line-segment, angle, triangle etc.
3. Numbers:-Writing 1 to 100 in numerals and words, missing number, after- before the given number, addition, subtraction etc.
4. Currency.
5. Calendar.

EXAMINATION 2
AGE: 6 RUNNING.
1. Revision
2. Numbers: - 6 digit numbers, write a number in expanded form, place values of the digits in the number, multiplication, division, number line, tables from 2 to 30, etc.
3. Application of Calendar, Clock and currency.
4. Standard measures of length, weight, capacity.

EXAMINATION 3
AGE: 7 RUNNING.
1. Revision
2. [1] 10 digit numbers- write a number in expanded form, place values of the digits in the number, multiplication, division etc.
   [2] Classification of numbers as (1) odd and even numbers (2) prime and composite numbers. [3] Roman numerals etc.
3. Prime factors of the given number. L.C.M. and G.C.D.
4. Shapes: [1] Rectangle, Square, Circle—their properties. [2]Cube, Cuboids (parallelepiped), Right circular Cylinder, Cone, Sphere, Pyramid – their faces, edges, corners, Euler's rule etc.
5. Constructions:- (1) Draw a line segment of (I) given Length (II) double it (III) triple it. (2) Draw angles of given measure

EXAMINATION 4
AGE: 8 RUNNING.
1. Revision
2. Numbers:- Common multiples, Common factors, L.C.M. and G.C.D. Application of L.C.M. and G.C.D.

3. Multiplication methods from "Vedic Ganit" as Nikhilam method, Ganesh method etc.
4. Vulgar fractions:- (common fractions) Introduction, equivalent fractions, comparison, addition, subtraction, proper; improper; mixed fractions, Its applications.
5. Perimeter of any closed figure, collinear and non-collinear points; segments; rays, coplanar and non-coplanar points; segments; rays; lines, concurrent lines etc.

EXAMINATION 5
AGE: 9 RUNNING.
1. Revision
2. Bodmas, Average, Percentage.
3. Integers:- Square and square-roots cubes and cube-roots, Vedic-methods for this etc
4. Magic squares. Replace letter;* by proper digit in Alphamatics.
5. Introduction of combinatorics.
6. Count number of triangles, squares, rectangles in the given figure.
7. Properties of triangles-(I) Sum of three angles of a triangle is 180. (II) Sum of any two sides of a triangle is always greater than the third side of the triangle. (III) In a triangle why not possible any 2 angles are right angles, 2 obtuse angles etc.
8. Area:- definition , area of closed figure. Unit area etc.
9. Clock – Examples based on angles.

EXAMINATION 6
AGE: 10 RUNNING.
1. Revision- Bodmas.
2. Commercial mathematics.
3. Indices.
4. Algebraic expressions:- introduction, classification, addition, subtraction, linear equations. Etc.
5. Ratio, proportion, continued proportion etc.
6. Pair of angles.
7. Constructions:-Draw a perpendicular line at a given point, Draw parallel lines, Hexagon, Construction of angles (multiples of 60) with the help of ruler and compass.
8. Statistics:-graphs – draw and read.
9. Construction of triangles, quadrilaterals, tangents etc.

EXAMINATION 7
AGE: 11 RUNNING.
1. Revision
2. Polynomials:- definition, classification, addition, subtraction, multiplication, division etc.
3. Linear equations with two variables, graphs and application also.
4. Factorization:-of linear and quadratic expressions. H.C.F. And L.C.M. of algebraic expressions.
5. Sequences and series:- n^{th} term, sum of first n terms of A.P. and G.P. etc
6. Pigeon hole principle, Modular numbers etc.
7. Set theory.
8. Mensuration.
9. Statistics:- Pie chart, column chart etc.
10. Congruence of triangles.

EXAMINATION 8
AGE: 12 RUNNING.

1. Revision
2. Theorems and properties of triangles.
3. Theorems and properties of quadrilaterals.
4. Loci theorems.
5. Quadratic equations:- 3 methods of solving equation, Comment on discriminant, form an equation having given roots, graph, and application also.
6. Volume and surface areas.
7. Similarity of triangles.
8. Trigonometric ratios:- Introduction, fundamental relations, Express all 5 in terms of the given ratio etc.
9. Important identities:- $\sin^2 A + \cos^2 A = 1$ etc. Inverse Functions, properties of triangle- sine rule, Cosine rule etc.
10. Binomial theorem, Pascal's triangle.
11. Area of a circle, sector, segment etc.

EXAMINATION 9
AGE: 13 RUNNING.
1. Revision
2. Statistics:- mean, mode, median etc.
3. Determinants.
4. Combinotrics.
5. Circle:- Tangents, chords, general equation etc.
6. Trigonometric ratios:- heights and distances, its application
7. Mathematical induction.
8. Functions:- domain, range etc.

EXAMINATION 10
AGE: 14 RUNNING.
1. Revision
2. Trigonometry:- graphs of Trigonometric ratios, Trigonometric ratios of(-A), (90+A), (90 – A), (180+A), (180-A), etc. sin(A+B), cos(A+B), tan (A+B), sin2A, cos2A, tan2A etc.
3. Probability.
4. Complex numbers.
5. Co- ordinate system.
6. Limits.
7. Differentiation.
8. Matrices.
9. Linear programming.
10. Mathematical logic and application.

Students can learn this without disturbing the school curriculum and their other activities. Those who are sharp and keenly interested can appear twice in a year. Although a student appearing once in a year can complete this programme at the age of 14 years running.

5. RESULTS

As said previously, I am already running a shorter version of this programme on my own. And the results that I have are really fantastic. After completing this programme, students learn to enjoy mathematics. They understand when and how a mathematical techniques to be used. In my opinion that is very important.

The programme was helpful for junior mathematical Olympiad (Jr.M.O.) conducted by Bhaskaracharya Pratishthan. Some of my students cleared Jr.M.O. in 7th standard. Many of

the students went on to clear regional mathematical Olympiad R.M.O. in 9th standard. Some of them also managed to do very well in Indian National Mathematical Olympiad (I.N.M.O.) in 9th standard.

There is an examination called Mathex, conducted by 'Maharashtra Mathematics Teachers Association'. It is for 5th & 8th standard students. The result of our institute is always 100% while for almost all other institutes it is below 10%. Many students has received 'National Talent Search Examination(NTSE) scholarship' awarded by Govt. of India and some of them have also received highly prestigious 'Young Scientist Fellowship' awarded by KVPY, Indian Institute of Sciences & Govt. of India.

A couple of my students are gold medallist in Physics & astrophysics Olympiad also and few of the students are now completing their higher secondary education in well known school at London U.K. Some of my past students are now completing graduation programme in well known universities in U.S. I have always received very encouraging feedback from my students and their parents.

My best student is a winner of Shrinivas Ramanujan Award offered by Trinity College, Cambridge, UK for doing a Ph.D. in Mathematics at Trinity college. I am proud to say that he is my son. My experience of teaching maths to my son is the main inspiration behind having such a programme.

I am sure the results will improve even more once the programme spreads widely. I want to start implementing this programme along with mathematical training in a wider capacity soon. But this of course requires a lot institutional efforts and I will be delighted if someone is ready to offer a helping hand.

6. REFERENCES

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