TRY OUT OF A TRAINING PACKAGE FOR THE PLUS TWO LEVEL TEACHERS OF MATHEMATICS

THREE WEEK WORKSHOP

10th to 30th June 1996

A Report

Regional Institute of Education, Mysore - 570 006
(National Council of Educational Research & Training, New Delhi - 110 016)

1996

A REPORT BY THE ACADEMIC CO- ORDINATOR

Background and Objectives

Need to upgrade periodically the professional competence of teachers at all levels in general and senior secondary teachers in particular cannot be overemphasized. In recent times, introduction of career advancement schemes have made it obligatory for the plus two level teachers to undergo refresher courses of three weeks duration. Hence there is a felt need for a training or enrichment package designed to cater to the special needs of plus two level teachers. With these considerations in view, the faculty of Mathematics at RIE (Resource Group) set about initiating action in this direction with the following objectives.

1. To develop package of enrichment material called the 'training package' for the plus two level teachers.
2. To try out the training package with a group of working teachers from K.V.S. and Navodaya Schools in a three week workshop.

Planning :

Planning consisted of two stages.

Stage 1: Planning for the development of training package.

Stage 2: Planning for the conduct of three week workshop to try out the training package.

As a first step towards realization of the declared objectives, a calender of activities was drawn up as detailed below.

1.	April 1 to April 30, 1996	Completion of writing work by individual faculty members.
2.	May 1 to May 25, 1996	Editing, proof reading and getting the typescript ready.
3.	May 30 to June 9, 1996	Getting ready the 50 xeroxed copies of the 3 volume training package.
4.	June 10 to June 30, 1996	Conduct of the 3-week workshop to try out the training package.

The modalities involved in the writing of enrichment material were worked out by the resource group after mutual consultations and meetings. Here are the outcomes.

1. Selection of topics: The training package was to be based on the content discussed in the NCERT Mathematics textbooks prescribed for classes XI and XII. The topics generally found difficult to transact in the classroom by the working teachers were to be included. Consequently, the following topics (units) were selected.

Vol.1	Number System, Vectors and 3D Geometry
Vol.2	Differential and Integral Calculus, Differential Equations
Vol.3	Probability, Linear Programming, Numerical Methods, Flow Charts, and Computing

2. Guidelines : To ensure uniformity of approach, style and presentation, detailed guidelines containing specific instructions for the authors of the enrichment package were agreed upon.

A copy of the guidelines is appended.

3. Common Format : In preparation of each unit, the authors were to conform to the following common format.

i) Introduction

ii) Resume of Key Concepts and Results

iii) Areas of difficulty - discussion in detail keeping in mind the guidelines.

iv) Self test and assignment

The writing work was distributed unitwise among the members of the resource group.

The members of the resource group were

1. Dr.G.Ravindra, Professor of Mathematics, RIE, Bhopal.
2. Dr.V.Shankaram, Reader in Mathematics, RIE, Mysore
3. Dr.N.M.Rao, Reader in Mathematics, RIE, Mysore
4. Dr.B.S.P.Raju, Reader in Mathematics, RIE, Bhopal
5. Dr.B.S.Upadhyaya, Reader in Mathematics, RIE, Mysore

6. Dr.D.Basavayya, Reader in Mathematics, RIE, Mysore
7. Mr.B.C.Basti, Lecturer in Mathematics, RIE, Bhopal
8. Mrs.S.Vasantha, Lecturer in Mathematics, RIE, Mysore
9. Dr.N.B.Badrinarayan, Reader in Mathematics (Retd), RIE, Mysore

Editing team comprised of Dr.V.Shankaram, Head, Mathematics Section and Mrs.S.Vasantha, the Academic Coordinator.

After editing and proof reading, final typescript of the enrichment package was ready by 31.5.1996.

Fifty xeroxed copies of the training package in three volumes were ready for use in the 3-week workshop to begin from 10th June 1996.

Workshop Details :

Eight P.G. teachers drawn from Navodaya Vidyalaya Schools participated in the workshop. In the opening session, it was made clear to the participants that each evening they must critically study those units which were scheduled for discussion on the next day. The importance of making notes on points of clarification, solving problems in the self-test and assignment were underlined.

The strategies used in the workshop :

1. On an average, five hours were devoted to the d iscussion of each unit of the enrichment package.

2. Pedagogic issues like Learning Principles, Adolescent Psychology, teaching strategies, Evaluation, Teaching Aids and Club Activities etc. were discussed in the afternoon sessions everyday.

3. Lecture synopses/handouts were distributed to highlight the key issues related to the teaching of Mathematics.

4. In addition to the problem solving work in the regular lecture cum discussion classes, five hours were specially earmarked for problem solving. To facilitate experience in problem solving, work sheets containing challenging problems were supplied.

5. Each participant gave a seminar on a topic related to the content or pedagogy of Mathematics.

6. Two special lectures aimed at deeper understanding and enrichment were arranged.

7. To provide hands-on experience with the computers, three sessions of two and a half hour duration each were provided.

8. Films related to topics of Mathematics at +2 level were screened once a week for the benefit of participants.

9. Maths Club activities and preparation of teaching aids were discussed. Participants studied the various teaching aids displayed in the Maths Lab.

10. In order to find out the extent of assimilation of knowledge imparted to the participants through the training package, a post test was administered to the participants which in turn was analysed to form the impressions about the participants and the success of the workshop.

11. With a view to allow free expression of opinions on (i) the enrichment package and (ii) various aspects of the workshop, two questionnaires were circulated among the participants.

12. Necessary library books were made available to the participants.

Workshop Schedule:

The daily schedule of the workshop conducted at RIE, Mysore was :

1. Working hours : 9.30 am to 4.45 pm (with a lunch break between 12.45 pm to 2 pm)
2. Forenoon Sessions : Two lecture cum discussion sessions of an hour and a half each.
3. Afternoon Sessions : Topics of Pedagogic interest, participatory activities or Group Work.

A copy of the time table is appended.

Participants' Impressions about the Training Package :

Following aspects were covered in the questionnaire on the effectiveness of the training package.

1. Choice of the units/topics, extent and depth of coverage.
2. Language used and the style of writing, presentation.
3. Relevance of the package in relation to the needs of +2 level teachers.
4. Accuracy or correctness of the content.
5. Weightage given to problem solving in the package.
6. Choice and number of problems given in Self Test and Assignments.
7. Extent of motivation provided by way of illustrations drawn from nature, relevance to daily life, historical backdrop, etc.
8. Adequacy, clarity and correctness of diagrams/illustrations/figures.
9. Quality of proof reading, typographical errors, errors in the answers to the exercises provided.

Any other aspects not covered.

Participants' responses are summarised below.

1. Presentation was good, language easy to understand and they liked the style.

2. Majority of participants felt that topics like i) Matrices, ii) Analytical Geometry, iii) Trigonometry could have been included.

3. The package was useful to all teachers at +2 level; more so to the new teachers.

4. A majority of participants expressed happiness that the exposition of content is interesting and many ideas contained were new to them.

5. Exercises provided in the package were satisfactory. It was unanimously felt that Multiple Choice Test items should have been included at the end of each unit.

6. While many chapters were error free, there were some units in the package which contained proof reading errors.

Participants' reactions to the Workshop :

A questionnaire seeking the reactions of the participants on the following aspects of the workshop was circulated among them.

1. The extent to which objectives of the workshop was achieved.
2. Choice of the topics in workshop in relation to their needs.
3. Various activities of the workshop.
4. Daily schedule and duration of the workshop.
5. Instructional Material supplied.
6. Topics which needed to be covered but did not find a place in the workshop.
7. Any other academic aspect not found in the questionnaire.

Besides, the faculty members used to interact informally with the participants and gather their views.

The views of the participants on the conduct of workshop are summed up below.

1. The objectives related to content enrichment were fulfilled to a satisfactory extent while the ones related to methodology were partially fulfilled.
2. Topics selected were adequate to meet the classroom needs.
3. Procedure followed by the resource persons' exposition and discussion of the topics were highly satisfactory.
4. The various activities during the workshop were relevant to their needs.

5. Daily working hours of the workshop was alright.

6. The duration of three weeks was too long.

7. Instructional materials/synopses provided during the workshop were useful.

8. Library hours must be provided in the time table itself.

9. A good collection of multiple choice test items would be of great help.

Impressions, Suggestions and Reactions of the Faculty :

The assignment of development and tryout of the training package was taken seriously by the resource group and a lot of hardwork had gone into it. Hardly nine P.G. teachers turned up for the workshop instead of the expected thirty. This caused a lot of disappointment and dismay among the resource persons. In future, it would be desirable to ensure participation of the expected number of teachers.

The participants were enthusiastic and had a receptive attitude. However, a little more initiative on their part would have made a difference for the better.

Participants were unable to use the library for reference work before and after the working hours, as the library timings were not suitable.

The resource persons felt that it would be fruitful to have more seminar hours in the workshop.

It was felt that better interaction could have taken place in the discussion classes if each of the participants had worked through the units of the package beforehand, more thoroughly and raised specific doubts.

Performance in the post test indicated that although the overall understanding of content/concepts had improved, their problem solving skills still needed to be sharpened and fine tuned. This being a long term process, exercises like 1. Problem Construction, 2. Problem Solving, 3. Content Analysis initiated at the workshop must be persued and continued by the participants, seeking further assistance and clarifications if need be, from the faculty of Mathematics of RIE.

LIST OF RESOURCE PERSONS

1. Mrs.S.Vasantha, Lecturer in Mathematics, RIE, Mysore - ACADEMIC COORDINATOR
2. Dr.G.Ravindra, Professor of Mathematics, RIE, Bhopal
3. Dr.V.Shankaram, Reader in Mathematics, RIE, Mysore
4. Dr.N.M.Rao, Reader in Mathematics, RIE, Mysore
5. Dr.D.Basavayya, Reader in Mathematics, RIE, Mysore
6. Dr.B.S.Upadhyaya, Reader in Mathematics, RIE, Mysore
7. Dr.N.B.Badrinarayan, Reader in Mathematics (Retd), RIE, Mysore
8. Dr.G.N.M.Dixit, Reader in Mathematics, JCE, Mysore

Acknowledgement :

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1. The Principal Dr.S.T.V.G.Acharyulu
2. Dr.G.N.M.Dixit, Reader in Mathematics, JCE, Mysore
3. Dr.N.B.Badrinarayan, Retd. Reader in Mathematics, RIE, Mysore
4. Dr.Gopalan, Professor Emeritus, JCE, Mysore
5. The Dept. of Extension Education, RIE, Mysore
6. Esteemed colleagues in the Mathematics Section, RIE, Mysore
7. Dr.Sudha V Rao, Reader in Education, RIE, Mysore.

Workshop for the Development and Tryout of a Training Package in Mathematics for teachers at +2 level
(10 - 30 June 1996)

Day & Date	9.30 - 11.00	11.15 - 12.45	2.00 - 3.15	3.30 - 4.45
10.6.96 Monday	Registration & Club Activities		Evaluation (NBB)	Math. Edn at +2 level
11.6.96 Tuesday	Probability-1 DB	Number System-1 BSU	Problem Solving I - NBB	Film Show
12.6.96 Wednesday	Probability-2 DB	Vectors - 1 NBB	Error Analysis - 1	(DB and VS) --------
13.6.96 Thursday	Probability-3 DB	Vectors - 2 NBB	--------- Computer	Lab. (DB)----------
14.6.96 Friday	Algorithm and Flow Charts-DB	Vectors - 3 NBB	GNM-1 Principles of Learning Maths	Error Analysis - 2 DB/VS
15.6.96 Saturday	NMR - 1	Vector - 4 NBB	---------- Computer	Lab. (BSU) ----------
16.6.96 Sunday				
17.6.96 Monday	Number System-2 BSU	3D Geometry-2 NMR	Problem Solving-1 NBB	Seminar
18.6.96 Tuesday	Number System-3 BSU	Numerical Methods 1 - GNM	Problem Solving-2 NBB	Film Show
19.6.96 Wednesday	3D Geometry-3 NMR	Numerical Methods 2- GNM	Math. Logic VS	Seminar
20.6.96 Thursday	Limits, Continuity & Derivatives (BSU)	Linear Programming 1 - GR	Learning Principles-2 GNM	Seminar

Day & Date	9.30 - 11.00	11.15 - 12.45
21.6.96 Friday	Linear Programming 2 - GR	Numerical Methods 3 - GNM
22.6.96 Saturday	Linear Programming 3 - GR	Limits, Continuity & Derivatives-2 BSU
23.6.96 Sunday	-------- LIBRARY	WORK
24.6.96 Monday	Applications of Derivatives-1(SV)	Derivatives-3 BSU
25.6.96 Tuesday	Integration - 1 VS	Differential Equations-1 (NBB)
26.6.96 Wednesday	Applications of Derivatives-2(SV)	Differential Equations-2 (NBB)
27.6.96 Thursday	Integration - 2 VS	Differential Equations-3 (NBB)
28.6.96 Friday	Integration - 3 VS	Differential Equations-4 (NBB)
29.6.96 Saturday	Applications-3 SV	Differential Equations-5 (NBB)
30.6.96 Sunday	------- POST TEST ----------	

2.00 - 3.15	3.30 - 4.45
Problem Solving 3 - NBB	Seminar
------ Computer Lab ----------	

Mathematical Modelling -GR	Film Show
Adolescent Psychology and Achievement in Mathematics (Dr.Sudha Rao)	
Instructional Strategies-1(GNM)	Seminar
Maths. Lab. SV	Seminar
Instructional Strategies-2 (GNM)	Seminar
-------- Computer Lab ----------	

SEMINAR TOPICS

As a part of workshop for the Development and Tryout of a Training Package in Mathematics for teachers at +2 level, the following faculty members from the Navodaya Schools talked on the topics mentioned against their names between 3.30 - 4.45 p.m. on the dates as detailed below.

1.	17.6.96	Sri S Pattabi 'Multiplication of Matrices'
2.	19.6.96	Sri Yadumondana 'Similar Triangles'
3.	20.6.96	Sri Ramesh 'Binary Operations'
4.	21.6.96	Sri Shaji 'Applications of Calculus'
5.	26.6.96	Sri Lokabhiraman 'Coordinates'
6.	27.6.96	Kum.Sowdamini 'Projects in Mathematics'
7.	28.6.96	Kum.Mary 'Conditional and Biconditional statements'
8.	29.6.96	Sri Silvance 'Origin of Calculus'

Special Lectures :

1. Dr.G.Ravindra - Mathematical modelling
2. Dr.M.N.Gopalan - Probability Models

INDIVIDUAL REPORTS BY THE

MEMBERS OF THE RESOURCE GROUP

REPORT BY DR.V.SHANKARAM

Apart from taking active part in all the seminar sessions, the following contributions were made.

1. A lecture on "Trends and Changes in Mathematics Curriculum at +2 level" was given on 10.6.96.

   In this lecture, the salient features and important changes in Mathematics curriculum at +2 level in the Indian context from 1940s to date was outlined.

2. Three sessions were devoted to mathematical logic. The topics covered were a) Logical connectives, compound statements and truth tables, b) Testing the validity of an argument by truth table method, and c) Testing the validity of an argument by the use of Venn diagrams.

3. One session was devoted to Integral Calculus. The origin of differential and integral calculi, the relationship between the two and how to introduce these at +2 level were discussed. How to teach the fundamental theorem of integral calculus was also highlighted.

4, Three sessions were devoted to analysis of errors committed in mathematics in P.U.C. examination of Karnataka. Each participant was given an answer script. They were asked to identify the errors committed therein and classify them according to a format provided to them.

COMPUTER LABORATORY PRACTICAL SESSIONS

Dr.B.S.Upadhyaya

In these sessions, emphasis was laid on individual hands on experience with the computers. Totally there were four sessions, each of two and a half hour duration. The participants were keenly interested in working with the computers.

The following aspects were covered.

1. Scope of computers in general and in Education in particular.
2. Key board familiarity
3. Use of ready made secondary and higher secondary Mathematics software as teaching/learning aids.
4. Basics of the Basic Language
5. Writing small programmes in Basic for the use in secondary and higher secondary Mathematics classes.
6. Use of computers for Recreations (in Mathematics).

The participants felt that a few more sessions of computer lab. work would have been welcome.

MATHEMATICS LABORATORY ACTIVITIES

Mrs.S.Vasantha

In two sessions, each of an hour duration, the participants were introduced to a variety of teaching aids/charts/puzzles available in the Lab. pertaining to primary, secondary and senior secondary levels. In particular, they studied some of the teaching aids useful for +2 level classes. Some examples are given here.

1. 3-D grid
2. Clinometer
3. Logic boxes
4. Ruled surfaces, conic sections
5. Repeated decimal wheel
6. Napier's rods
7. Curve stitching patterns
8. Polyhedral solids
9. Number properties
10. Quizes and Puzzles

The participants showed keen interest in teaching aids used in lower classes. A discussion on (1) How far teaching aids could be of help at the senior secondary level, and (2) How to use the teaching aids effectively in the classroom, took place in these sessions.

FILM SHOWS

Following films were screened for the benefit of the participants.

1. Binomial Theorem
2. Complex Numbers
3. Conic Sections

LECTURE SYNOPSIS 2

Problem Solving

Introduction : Problem solving has a pride of place in Mathematics. Primarily problem solving is an intellectual activity. Broadly, problem solving connotes that it is a method of finding a way out of difficulty. In daily life, we will be solving problem of one type or the other almost everytime. Some of them are simple while others are sufficiently complex. However, problem solving in mathematics is hardly different from learning mathematics. We learn mathematics to solve mathematical problems and in turn solve problems to learn mathematics better. The proof of learning mathematics is essentially to be able to solve mathematical problems.

Structurally, the body of knowledge called mathematics is a chain of results logically and sequentially built. The link between any two results in mathematics is the mathematical logic. In mathematics, we have definitions terminology, symbolism and results relating these. Almost every mathematical result looks like 'If A then B' or '$A \Rightarrow B$' or 'A if and only if B' or $A \Leftrightarrow B$. Formulas are also mathematical results put rather crisply.

A problem in mathematics seeks a consequence which would logically follow from one or more assumptions (hypothesis). The passage from what we know in a problem to the end result is problem solving. Analysing the given problem is the very essential first step towards problem solving. This step means identifying the data, the definitions and the assumed results and understanding what is sought in the problem.

A sound knowledge of mathematical results which are used in problem solving is a must for solving the given problem. However, this knowledge alone will not ensure the solution of the problem. Most important of all is the recognition of the key idea which helps one to solve the problem. The key idea may come in

any form - be it recognising the results/formulas to be used, or a suggestion from the solution which is to be arrived at. Once the key idea flashes a cross, the solution is insight. One way of solving a problem often helps us to find alternate, more economical and more elegant ways of solving the problem. In what follows, we illustrate these through problem solving exercises.

Examples :

1. Problem: a,b,c and p,q,r are in A.P. Find the common root of the equations $ax^2+2bx+c = 0$ and $px^2+2qn + r = 0$

Key Idea: $2b = a + c$, $2q = p + r$

Since a,b,c and p,q,r are in A.P.

Then the given equations will have (x+1) as a common factor.

So that -1 is the common root.

Check: When -1 is a root of the equations

$a - 2b + c = 0 = p - 2q + r$

$\Rightarrow b = \frac{a+c}{2}$, $q = \frac{p+r}{2}$

$\Rightarrow$ a,b,c and p,q,r are in A.P.

2. Is $f(x) = |\cos x|$ differentiable at $x = \pi/2$

Key Idea: i. $f(x) = |\cos x| = \cos x \leq \pi/2$

$= -\cos x \geq \pi/2$

$f(\pi/2) = 0$

ii. For differentiability at $x = \pi/2$

$$\lim_{h\to 0} \frac{f(\pi/2 - h) - f(\pi/2)}{h} = \lim_{h\to 0} \frac{f(\pi/2 + h) - f(\pi/2)}{h}$$

$\Rightarrow -1 \neq +1$

$\therefore$ f(x) is not differentiable at $x = \pi/2$.

3. Which are the nearest points of $x^2-y^2=1$ to A(4,0).

Key Idea: Let P (Sec θ, Tan θ) be a point on $x^2-y^2=1$.

$AP^2 = (\text{Sec}\theta - 4)^2 + \text{Tan}^2\theta = 2\,\text{Sec}^2\theta - 8\,\text{Sec}\theta + 15$

$= 2(\sec\theta - 2)^2 + 7$

$AP^2 \geq 7 \therefore AP\ (\text{least}) = \sqrt{7}$

Then $\sec\theta = 2$, $\text{Tan}\,\theta = \sqrt{\sec^2\theta - 1} = \sqrt{3}$

The points of the curve closest to A(4,0) are $(2, \pm\sqrt{3})$.

4. What does $(1+i)Z = (1-i)\bar{Z}$ represent ?

Key Idea: Taking $Z = x+iy$, $\bar{Z} = x-iy$.

The given equation $(1+i)(x+iy) = (1-i)(x-iy)$

$\Rightarrow \quad 2i(x+y) = 0 \quad \Rightarrow \quad x+y = 0$

The given equation represents the bisector of the 2nd and 4th quadrants.

5. Find the value of $\frac{1}{\lfloor 1 \lfloor n-1} + \frac{1}{\lfloor 3 \lfloor n-3} + \cdots + \frac{1}{\lfloor n-1 \lfloor 1}$

Key Idea: (1) ${}^nC_r = \frac{\lfloor n}{\lfloor r \lfloor n-r}$ (2) ${}^nC_1 + {}^nC_2 + \cdots + {}^nC_{n-1} = 2^{n-1}$.

Given expression $= \frac{1}{\lfloor n}\left[\frac{\lfloor n}{\lfloor 1 \cdot \lfloor n-1} + \frac{\lfloor n}{\lfloor 3 \lfloor n-3} + \cdots\right]$

$= \frac{1}{\lfloor n}\left[{}^nC_1 + {}^nC_2 + \cdots {}^nC_{n-1}\right]$

$= \frac{2^{n-1}}{\lfloor n}$

6. What type of $\triangle ABC$ if $4(\sin^2A + \sin^2B + \sin^2C) = 9$.

Rewriting the condition

$2\left[2\sin^2A + 2\sin^2B + 2\sin^2C\right] = 9$

$\Rightarrow 2\left[1-\cos 2A + 1 - \cos 2B + 1 - \cos 2C\right] = 9$

$\Rightarrow 2\{-(\cos 2A + \cos 2B + \cos 2C)\} + 3 = 0$

$\Rightarrow 2\{-[2\cos(A+B)\cos(A-B) + 2\cos^2 C - 1]\} + 3 = 0$

$\Rightarrow 4\cos^2 C - 4\cos(A-B)\cos C + 1 = 0$

Cos C is real

$\therefore 4\cos(A-B)^2 - 4.4.1 \geq 0$

$\therefore \cos^2(A-B) \geq 1$

$\Rightarrow A-B = 0$ or $A = B$

$\|\|ly\ B = C$

Hence $A=B=C$. $\therefore$ The $\triangle ABC$ is an equilateral triangle.

Key Idea: 1. If roots of a quadratic equations are real, then its discriminant ≥ 0.

2. Transformation formulae of Trigonometry.

Exercise : Identify the key idea(s) in each of the following problems.

1. Examine $f(x) = \left|\frac{x}{x}\right|$, $x \neq 0$,
   $f(0) = 0$
   for continuity at $x = 0$.

2. Evaluate $\int \log\left(x + \sqrt{x^2-a^2}\right)\, dx$

3. Find x so that $f(x) = x^3-6x^2-36x+2$ is increasing.

4. Find A in triangle ABC, if $4s(s-a) = 3bc$.

5. The circle $x^2+y^2-4x-4y+4 = 0$ is inscribed in a triangle, two of whose sides are the coordinate axes. Find the locus of the circumcentre of the triangle.

6. The sides of a triangle are in A.P. Its greatest angle exceeds the least angle by α. Then show that sides are as $(1-x) : 1 : (1+x)$ where $x = \sqrt{\frac{1-\cos\alpha}{7-\cos\alpha}}$

7. S.T. $\begin{vmatrix} a-b-c & 2a & 2a \\ 2b & b-c-a & 2b \\ 2c & 2c & c-a-b \end{vmatrix}$ is a perfect cube.

8. S.T. $\frac{{}^{n}c_1}{1} - \frac{{}^{n}c_2}{2} + \frac{{}^{n}c_3}{3} = \ldots + (-1)^{n-1} \frac{{}^{n}c_n}{n}$

$= 1 + \frac{1}{2} + \frac{1}{3} + \ldots + \frac{1}{n}$

9. Determine all the values of m for which Sin x + m Cosx = 2m has real solutions.

10. Eliminate α , β from the equations

$a \sin^2\alpha + b \cos^2\alpha = 1$

$a \cos^2\beta + b \sin^2\beta = 1$

and $a \tan\alpha = b \tan\beta$.

LECTURE SYNOPSIS 1

Evaluation - Question Paper Analysis

Dr.N.B.Badrinarayan

Introductory Remarks:

It is common knowledge that to construct the tools to assess scholastic achievements of pupils, the teacher who uses the tools must take into consideration a variety of factors. These factors include the scope and extent of the content, the pupils' level and the duration of instruction of the content. A lot of care is necessary to design the tools of evaluation. One rallying point around which tests and examinations are woven is the purpose of the course. Nothing is more revealing of the purpose underlying a course of study than the nature of the examination administered to the pupils at the end of the course. Nothing is more effective in telling the pupils what we want him/her to do than the method we use to find out the extent of his achievement.

Guidelines for a question paper :

Planning to construct a question paper involves a number of decisions some of which receive explicit attention. While some decisions will be available as a prescription from the Board of examinations/syllabus committee/publication units ,etc. Some others are necessarily to be taken by the individual paper setter. Let us have a look at these.

1. Timing of the examination
2. Duration of the paper
3. Maximum marks
4. Types of questions
5. Number of questions
6. Distribution of marks per question
7. Weightages to various aspects

Then the design of the question paper emerges as a result of decisions on the various points.

With the design ready, it is now a task of constructing the items of various types, on different topics tested or selecting them from a question bank if there is one containing standardised test items. Every item constructed for the paper or included in the paper from a bank must be tested to find out i) the correctness, ii) the suitability, iii) difficulty level and iv) time consumed. A blue print of the question paper is a cross check to assure that all the aspects and decisions are reflected in the question paper.

Question paper analysis - A sample

The paper analysed was the mathematics question paper for XII Standard of the CBSE 1996 (April).

Excerpts from the C.B.S.E. guidelines for paper setting

1. Markwise weightage to different units.

Sl.No.	Unit	Marks
1.	Determinants and Matrices	15
2.	Functions, Limits and Continuity	04
3.	Differentiation	07
4.	Application of derivative	09
5.	Integration	22
6.	Differential Equations	08
7.	Vectors	08
8.	Three dimensional Geometry	10
9.	Probability	09
10.	Correlation and Regression	08
	Total	100

2. Weightages - Learning Outcomes

Sl.No.	Learning Outcomes	Marks
1.	Knowledge (K)	32
2.	Understanding (U)	45
3.	Application (A)	20
4.	Skill (S)	03
	Total	100

3. Weightages - Forms of questions

Sl.No.	Forms of questions	Marks per question	Number of Questions	Marks
1.	Very Short Answer Type (VSAT)	2	15	30
2.	Short Answer Type (SAT)	3	15	45
3.	Long Answer Type (LAT)	5	05	25
	Total			100

4. Weightages - Difficulty Level

Sl.No.	Estimated Difficulty Level	Marks
1.	Easy	15
2.	Average	70
3.	Difficult	15
	Total	100

Question Paper Blue Print - Format

Sl.No.	Content/Marks Questions / Learning Outcomes	V.S.A.T. K U A S	S.A.T. K U A S	L.A.T. K U A S
1.	Dets and Matrices			
2.	Functions, Limits, Continuity			
3.	Differentiation			
4.	Application of a derivative			
5.	Integration			
6.	Differential Equations			
7.	Vectors			
8.	3-D Geometry			
9.	Probability			
10.	Correlation and Regression			

Actual weightage as per the Group Study of the Question Paper is given in the following.

Content	VSAT	SAT	LAT	Total
1. Dets and Matrices	1+1 (2)	1+1 (2)	1 (1)	(2)+(2)+(1) = 15 2 3 5
2. Functions, Limits & Continuity	1 (1)			(1) = 2 2
3. Differentiation	1 (1)	1 (1)		(1) + (1) = 5 2 3
4. Application of Derivative	1 (1)	1+1 (2)	1 (1)	(1)+(2)+(1) = 13 2 3 5
5. Integration	1+1+1+1+1 (5)	1+1+1+1(4)		(5)+(4) = 22 2 3
6. Differential Equations		1 (1)	1 (1)	(1)+(1) = 8 3 5
7. Vectors	1 (1)	1+1 (2)		(1)+(2) = 8 2 3
8. Three-D Geometry	1 (1)	1 (1)	1 (1)	(1)+(1)+(1) = 10 2 3 5
9. Probability	1+1+1(3)	1 (1)		(3)+(1) = 9 2 3
10. Correlation & Regression		1 (1)	1 (1)	(1)+(1) = 8 3 5
Total	(15)=30 2	(15)=45 3	(5)=25 5	=100

ROLE OF MATHEMATICAL MODELLING IN TEACHING OF MATHEMATICS

Dr.G.Ravindra

A mathematical model is a simplified mathematical representation of a real situation. Some of the most important components of teaching a concept in mathematics are : Motivation for the concept, Simplication of concept, Problem solving. Mathematical modeling cuts across all the three components and each is greatly felicitated by mathematical modeling. Thus mathematical modeling has a great role to play in teaching of mathematics.

Some of the most important components of teaching a concept in mathematics are :

i) Motivation for the concept
ii) Simplification of the concept
iii) Problem solving

Motivation for learning a mathematical concept may be within the mathematics itself or outside the mathematics and a real world situation. For instance, it is very difficult to choose an example of an infinite set from a real world situation; so in such situation the set of natural numbers can be taken as a motivating factor for the concept of 'infinite sets'. On the other hand, a great deal of real world motivate and exemplify several concepts like vector, derivative, integral, etc.

Problem solving heavily depends upon the data of the problem (conditions or assumptions for the problem) and formulation of the problem (mathematical modeling).

Mathematical modeling cuts across all the three components : motivation, simplification and problem solving and each is greatly facilitated by mathematical modeling.

What is a Mathematical Model ?

A mathematical model is a simplified mathematical representation of a real situation. A set of natural numbers with usual addition and multiplication form a good mathematical model of a real situations concerned with counting process. Vectors are excellent mathematical models that predict and explain many physical phenomena with perfect accuracy.

Types of Models :

There are three types of models which are commonly used : iconic, analogue, and symbolic.

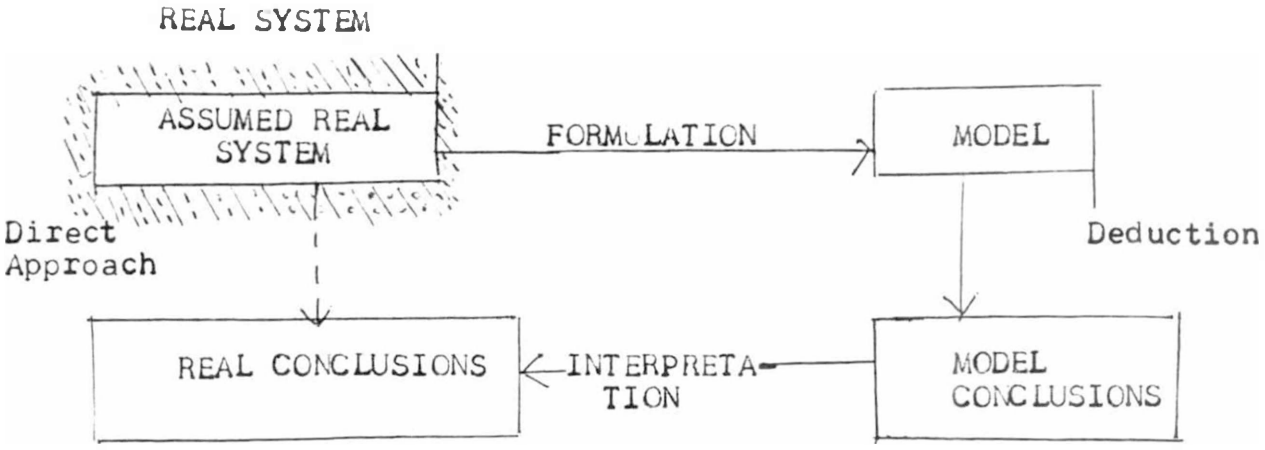
Iconic models are images; they represent the relevant properties of the real situations by the properties themselves, usually with a change of scale. These models generally look like what they represent but differ in size.

Analogues use one set of properties to represent another set of properties. For example graphs are analogues that use geometric magnitudes and location to represent a wide variety of variables and the relationship between them. Contour lines on a map are analogues of elevation.

Symbolic models use symbols, numbers to represent variables and relationship between them. Hence they are the most general and abstract type of models. Linear programming model, simple harmonic motion model are some of the examples of symbolic models.

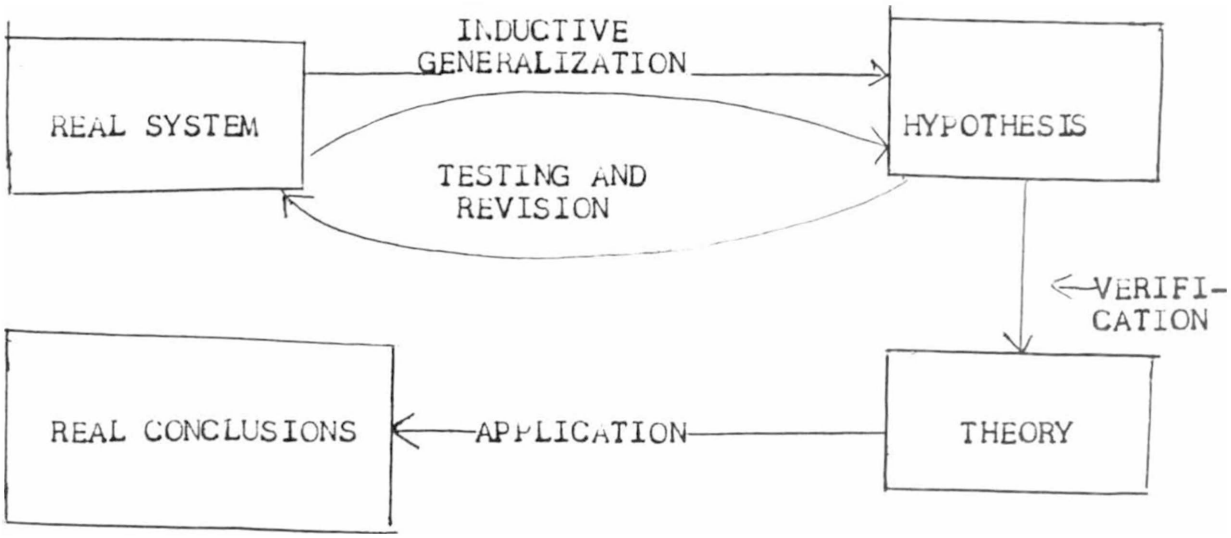
Process of Modeling:

The process of modelling is depicted in the following figure.



The first step is formulation of the model itself. The second step is to analyse the formulated model and deduce its conclusions. The final step, interpretation involves human judgement. The model conclusions must be translated to real world conclusions cautiously without discrepancies between the model and its real world referent.

Mathematical Modeling in contrast to experimentally based Scientific Method :



Here first step is development of a hypothesis which is arrived at generally by induction following a period of informal observation. An experiment is then devised to test the hypothesis of the experiment, if the result contradict the hypothesis, the hypothesis is revised and retested. The cycle continues until a verified hypothesis or 'theory' is obtained. The final result of the process is Truth, Knowledge or Law of Nature. In contrast to model conclusion theories are independently verifiable statements about factual matters. Models are invented; theories are discovered.

Some Mathematical Models :

1. A number theoretic model: In a party of people with atleast two persons, we are always assured of atleast two persons who know same number of persons in the party.

2. A maxima-minima model : Suppose an open box is made from a rectangular piece of tin a sq.mts by b sq. mts. By cutting out equal squares at each corner and folding up the remaining flaps. What size square should be cut out so that the box will have maximum volume ?

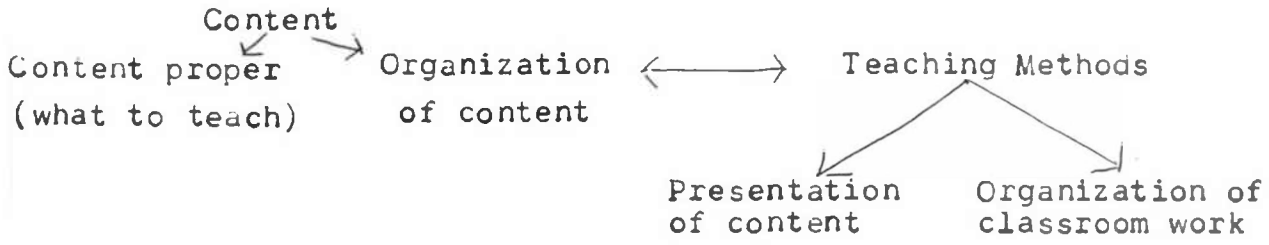
3. Graphs (Networks) as mathematical models: A graph (or network) is a non-empty set V together with an irreflexive and symmetric relation E on V.

Since the graphs are the most generalized algebraic structure they often work as excellent models of many real situations. The following examples are just two of those several situations which are easily modeled as graphs.

a) Shortest path problem: Suppose that we have a map of the form shown in the above figure (2) in which the letters A-L refer to towns which are connected by roads. If the lengths of these roads are as marked in the diagram, what is the length of the shortest path from A to L ? There are several methods which can be used to solve this problem. Possibly the simplest of these is to make a model of the map by knotting together pieces of string whose lengths are proportional to the lengths of the roads.

b) Scheduling Problem: Consider a collection C = Ci of courses being offered by a major university. Let T_i be the time interval during which course C_i is to take place. We would like to assign courses to classrooms, so that no two courses meet in the same room at the same time.

Content in mathematics can be analysed into content proper (what to teach) and its inner organization, the latter being most closely related to teaching methods. Teaching methods can be analysed into presentation of the subject matter (use of mathematical models etc) and organization of class room work, the former being most closely related to content and mathematical modelling. The analogue model of this para is as follows.



A NEED FOR ADOLESCENCE EDUCATION

A synopsis

Dr.Sudha V Rao

Adolescence means to grow up or to grow from childhood to maturity. Childhood, youth and old age form a tripartite age continuous in which adolescence occupies an important place. The school and the curricula have a powerful influence in shaping and changing an adolescents' life. It is a transition period from childhood to adulthood marked by rapid changes in physical, emotional and psychological in nature.

The main purpose of raising the issue of adolescence is basically to highlight its specific relevance at the lower as well as higher secondary education which include students in the age group of 14-18 years. Apart from biological adulthood, there is also the societal concept of adulthood i.e. social concept of adulthood which means a status in which the society considers a person mature and capable of carrying on socio-legal obligations.

There are several manifestations of various characteristics during adolescence. These broadly include cognitive development; emotional change; change in the body image; changes in attitudes; interests and inter-personal relationships; common source of difficulties experienced and; effect of adolescence on behavioural pattern.

Adolescence has traditionally been regarded as a period of stress and strain. The mood fluctuation manifests itself in unpredictable behaviour. These changes have major effects on health, attitude and the learning process inside and outside the classroom.

The Navodaya Vidyalaya schools being residential in nature, the participants raised a variety of adolescence related problems they face in their routine work. An interesting interaction outlining the possible solutions to their problems ensued.

A P P E N D I C E S

Guidelines for the development of training package for +2 level teachers :

A. The Enrichment material in the package has to

1. clarify doubts, remove misconceptions and provide the correct content.
2. enrich the knowledge in the content.
3. suggest new and effective strategies of teaching the content.
4. improve the understanding of the content.

B. It must be based on the content discussed in the NCERT Mathematics Texts for the CBSE (cited under reference).

C. It need not contain the very proofs of results found in the texts. However, for deeper understanding of the results , wherever necessary exhaustive treatment may be given.

D. Problem solving, involving the techniques has to get sufficient weightage.

E. Each topic is to have an assignment set with keys and hints if necessary.

F. Each topic is to contain more illustrations drawn from a variety of situations - from nature and life wherever possible and these illustrations should help in better understanding of the concepts and results.

G. The language should be in simple English in third person.

H. Each chapter to be covered over a convenient number of sections.

I. The introduction to the chapter should highlight the importance of the topic relative to mathematics, its use and historical backdrop.

QUESTIONNAIRE

Questionnaire to be filled by the participants of the Three Week workshop for +2 level teachers from 10th June to 30th June 1996.

1. Which of the following objectives were fulfilled during the workshop and to what extent ?

   a) Content Enrichment : Fully / Partially

   b) Methodology : Fully / Partially

2. Are the topics selected for discussion in the workshop adequate to meet your classroom needs ?

   Yes/No

3. Do you think that the topics were discussed satisfactorily ?

   Satisfactorily/ Partially satisfactory/ Unsatisfactory.

4. Give your opinion about the various activities during the workshop.

   a) Lectures : Too much / Adequate / Less

   b) Group work : Too much / Adequate / Less

   c) Discussions : Too much / Adequate / Less

   d) Tests : Unnecessary / Necessary / Adequate

5. Your opinion regarding the duration of the workshop daily and duration of the workshop:

   a) Daily working hours : More / less / Alright

   b) Duration (Total) of the workshop : More / Less / Alright

6. The instructional materials, worksheets and synopses are :

   Very useful / Useful to some extent / Not very useful.

7. List the topics which, in your opinion, should be covered in future workshop.

   1. 2.
   3. 4.

8. Give your opinion on Academic Aspects which are not covered above in two or three sentences each.

POST TEST

Instructions: Answer the question in a separate sheet of paper. Answers must be brief and precise.

1. Prove that $1.n = n$ for all natural numbers without using the commutativity of multiplication of natural numbers.

2. Prove that $(-a) \cdot (-b) = a \cdot b \quad \forall\ a,b \in I$.

3. Find the perpendicular distance from the origin to the plane,
$$\vec{r} \cdot (2\hat{i} - 3\hat{j} + 7\hat{k}) = 7$$
Also find the equation of a line passing through the point $(\hat{i} + 2\hat{j} - \hat{k})$ and perpendicular to the plane given above.

4. Prove or disprove (any two) :
   a) For some linear programming problems the set of feasible solutions is a disjoint union of convex sets.
   b) The set of feasible solutions of every linear programming problem is non-empty.
   c) Every linear programming problem is a mathematical model.

5. A man gives to his illiterate servant six addressed envelopes and six letters to put them in the respective envelopes. Find the probability that the servant misplaces the letters.

6. Translate the following argument into symbolic form, and test its validity.
   If there is a good course, then it is worth taking. Either the grading is lenient, or the course is not worth taking. But the grading is not lenient. So, this is not a good course.

7. Show that $(\vec{a} \times \vec{b}) \times \vec{c}$ is a vector lying in the plane of a and b.

8. Solve : $\frac{dy}{dx} = \frac{x+y}{x-y}$ given $y=1$ when $x = 0$.

9. Prepare a flow chart to pick up the largest of any three given numbers.

10. Find the reciprocal of 6 by Newton Raphson method, without actual division.

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POST TEST

Date:
Time:

Instructions: Tick the correct answer in the question paper itself.

1. Which of the following function is decreasing in $(0, \pi/2)$.

   a) Tan X b) Cos 2X c) Cos 3X d) log Sin X

2. The only function which possesses a maximum or minimum on R is

   a) e^X b) X^3 c) $|X+2|$ d) $2X+2$

3. The value of $\lim_{X \to \infty} X \sin \frac{1}{X}$ is

   a) 1 b) -1 c) 0 d) Does not exist

4. The function $f(X) = |X-2|$ is
   a) continuous and differentiable at X=2
   b) differentiable but not continuous at X=2
   c) continuous but not differentiable at X=2
   d) neither continuous nor differentiable at X=2

5. The equation $X^3+X^2+6 = 0$ has exactly one real root follows from
   a) Langrange's mean value theorem
   b) Cauchy's mean value theorem
   c) Rolle's theorem
   d) Intermediate value theorem

6. Given that 3 is an approximation to the real root of the equation $X^3-X^2-9 = 0$, the next approximation obtained by the Newton-Raphson's method is

   a) $2\frac{8}{9}$ b) $3\frac{1}{19}$ c) $3\frac{1}{21}$ d) $2\frac{9}{11}$

7. Simpson's rule is preferred over the Trapezoidal rule in evaluating a given integral when
   a) the number of sub-intervals is more.
   b) width of each sub-interval is small.
   c) the number of sub-intervals is even.
   d) the number of given points is even.

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Date:
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   a) the number of sub-intervals is more.
   b) width of each sub-interval is small.
   c) the number of sub-intervals is even.
   d) the number of given points is even.

8. $\vec{r}.(\hat{i} + 2\hat{j} - \hat{k}) = 3$ is

a) the equation of the line passing through (1,2,-1)

b) the equation of the plane passing through (1,2,-1)

c) the equation of the plane parallel to the vector (i+2j-k)

d) none of the above.

9. If G is the graph of a linear inequation in two variables, then which one of the following is not true.

a) G is a convex set.

b) G is a convex polygonal region.

c) G is contained in XY-plane.

d) The intersection of G with the first quadrant has at most three vertices.

10. Let P(X) denote the probability of an event X. $P(AB) = P(A)\,P(B)$ implies that

a) A and B are any two events.

b) A and B are mutually exclusive events.

c) A and B are dependent events.

d) A and B are independent events.

11. If $|a+b| = |a-b|$, then a and b are the sides of

a) quadrilaterial b) a parallelogram

c) a square d) a rectangle

12. The degree and order of the differential equation

$$\rho \frac{d^2y}{dx^2} = \left[1 + \left(\frac{dy}{dx}\right)^2\right]^{3/2}$$ are (ρ is a constant) respectively

a) 1 and 2 b) 2 and 2

c) 2 and 3 d) None of these

13. $\int_{a-c}^{b-c} f(x+c).dx$ is equal to

a) $\int_a^b f(x) \cdot dx$ b) $\int_a^c f(x) \cdot dx$

c) $\int_c^a f(x) \cdot dx$ d) $\int_b^c f(x) \cdot dx$

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