INTER UNIVERSITY CENTRE FOR TEACHER EDUCATION
REGIONAL INSTITUTE OF EDUCATION, MYSURU
(NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING, NEW DELHI)

ALTERNATIVE INSTRUCTIONAL STRATEGIES FOR TEACHING DIFFICULT CONCEPTS IN SCIENCE AND MATHEMATICS FOR TEACHER EDUCATORS

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PREFACE

At the secondary stage the students should be engaged in learning science as a composite discipline, in working with hands and tools to design more advanced technological modules than at the upper primary stage, and in activities and analysis on issues surrounding environment and health. Systematic experimentation as a tool to discover/verify theoretical principles, and working on locally significant projects involving science and technology are to be important parts of the curriculum at this stage. Knowledge and understanding are fundamental to studying mathematics and form the base from which to explore concepts and develop problem-solving skills. Through knowledge and understanding students develop mathematical reasoning to make deductions and solve problems.

Teaching difficult concepts in science and mathematics is an ongoing problem in schools across the country. In secondary level, many students are not able to understand the required concepts in science and mathematics and hence their performance is not as expected. Due to this reason they face problem to learn difficult-concepts in Science and Mathematics. One of the reasons for this problem may be accounted to the traditional instructional strategies employed by the teachers. Once teachers are aware of the appropriate alternative instructional strategies, they can implement them in their own classrooms which will be a remedy to the problems faced by them to teach difficult concepts in science and mathematics. Therefore teacher should be trained to design, develop and implement the alternative instructional strategies for teaching difficult concepts in science and mathematics.

In this context, IUCTE has developed on "Alternative Instructional Strategies for teaching difficult concepts in Science and Mathematics for teachers and teacher educators." The successful development of this resource material is the result of the cooperation, confidence, endurance and support given by Prof. Y. Sreekanth, Chairman IUCTE and Principal, RIE (NCERT), Mysore. I also owe my due respects and gratitude to Prof. M.S. Talawar, Director, IUCTE, Mysuru and Prof. V. D. Bhat, Professor IUCTE for all the academic support given for this work.

Dr.S.Prasannakumar
Associate Professor
IUCTE-RIEM

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A Three Day Workshop on
Designing Alternative Instructional Strategies for Teaching
Difficult Concepts in Science and Mathematics for Teacher Educators
(6 to 8 March 2019)

Introduction

Instructional strategies refer to the methods, techniques, procedures and processes that a teacher uses during instruction. These are strategies the teacher employs to assist student learning. Instructional strategies are techniques teachers use to help students to become independent learners. These strategies become learning strategies when teachers independently select the appropriate ones and use them effectively to accomplish tasks to meet the set goals.

Instructional strategies enable teachers to focus their attention, organize their learning material for better learning and also they help teachers to provide a suitable platform for strategic learning. The Alternative instructional strategies provide students with different approaches to learning the same content. Therefore, the selection of a strategy is critical and must be done with utmost care by teachers in coordination with their students.

Teaching difficult concepts in science and mathematics is an ongoing problem in schools across the country. At secondary level, many students are not able to understand the required concepts in science and mathematics and hence their performance is not as expected. Due to this reason they face problem to learn difficult-concepts in Science and Mathematics. One of the reasons for this problem may be accounted to the traditional instructional strategies employed by the teachers. Once teachers are aware of the appropriate alternative instructional strategies, they can implement them in their own classrooms which will be a remedy to the problems faced by them to teach difficult concepts in science and mathematics. Therefore teachers should be trained to design, develop and implement the alternative instructional strategies for teaching difficult concepts in science and mathematics. In this background a three day workshop was to be conducted on Designing Alternative Instructional Strategies for Teaching Difficult Concepts in Science and mathematics for Teacher Educators.

REPORT

Objectives of the Workshop

- To identify difficult concepts in science and mathematics at IX and X standard.
- To list out Instructional strategies
- To select alternative instructional strategies.
- To match the suitable alternative instructional strategies with the difficult concept
- To design alternative instructional strategies for teaching science and mathematics difficult concepts

Planning for the workshop

Programme Coordinator conducted survey to the teacher for identifying difficult concepts of IX and X standard Science and Maths lesson. He listed out number of the instructional strategies and circulated to the experts.

Day Wise proceeding of the workshop

Day -1, Date 6/03/2019

A three day Workshop on "Designing Alternative Instructional strategies for teaching difficult concepts in science and mathematics for classes IX and X was organized by Inter University Centre for Teacher Education, Regional Institute of Education (NCERT) Mysore on 6th to 8th March 2019. The inauguration was done by Prof. S. Ramaa, Principal In Charge and Dean of Instruction, RIE Mysore. Prof. M.S Talawar, Centre Director, delivered the Presidential address. Dr. K.K Murugan, Assistant Professor, Gandhigram Rural University, Gandhigram, spoke about importance of the workshop. Dr.S.Prasannakumar, the programme Coordinator presented the "concept note" on the workshop.

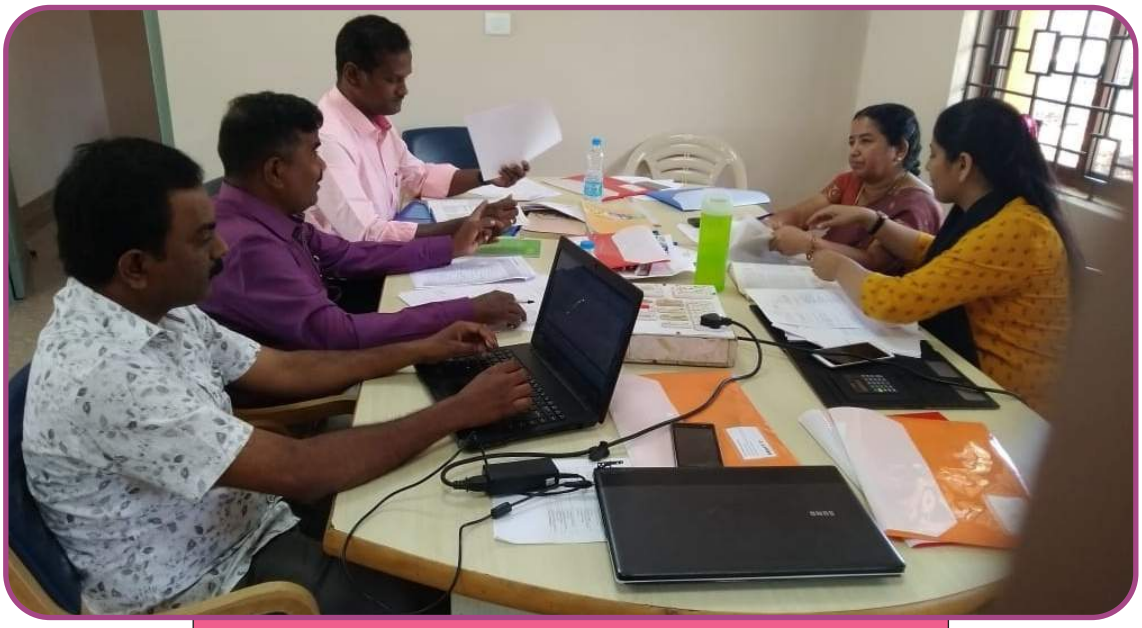
Inaugural session on 6th March 2019, Dr.Prasannakumar, Programme coordinator, delivered welcome address

The inaugural session of the workshop Prof.S.Ramaa, RIEM, Dr.S.Prasannakumar, Associate Professor, IUCTE, RIEM. Prof. M.S. Talawar, DirectTE, RIEM and Dr. K.K. Murugan, Assisrtant Professor, Gandhigram Rural Institute, Gandhigram.

There were two presentations. The first session was a presentation by Dr. Nagavalli, Associate Professor (Rted), Sarda College of Education, Salem, Tamilnadu. The title on "Instructional Strategies, Techniques and Methods" Dr.Nagavalli presented Strategies that determine the approach a teacher should take to achieve learning objectives. She classified Strategies as direct, indirect, interactive, experiential or independent. There were slots for detailed discussions and doubt clearing. There was a presentation by Dr.S.Prasannakumar, on "Teaching difficult concepts of Science through alternative instructional strategies". After this presentation, we conducted discussions and developed the lesson plan format for the Alternative instructional strategies. After this presentation, we conducted discussions and developed the lesson plan format for the Alternative instructional strategies.

Group activity was doing by the team of Science & Mathematics resource persons.

Group activity was doing by the team of Mathematics resource persons.



Group activity was doing by the team of Science resource persons.

Introduction on Instructional Strategies: Presented by Dr.Nagavalli, Associate Professor (Rted)
Sarada college of Education, Salem, Tamilnadu

The Programme Coordinator, Dr.S.Prasannakumar, presented on the theme of the workshop

Group activity was doing by the team of Mathematics resource persons.

In the afternoon session, the resource persons were divided into two groups one for science and another for mathematics. The Programme coordinator distributed the resource materials for the instructional strategies for classes IX and X. Also NCERT text books for science and mathematics at secondary levels were distributed. The list of difficult concepts in science and mathematics were distributed to the group. The resource persons discussed, shared their knowledge and they designed the alternative instructional strategy on the basis of each difficult concept should be teach by using two or more different strategies, methods and techniques. The end of the first day, they designed alternative instructional strategies for five difficult concepts in science and mathematics.

Mathematics group resource person presented the outcomes of the workshop.

Day-2, Date 07/03/2019

In the second day, during the first session, the experts presented report of the first day activities. First session was started by reporting previous day activities. In the second session the experts discussed and developed alternative strategies with appropriate learning activities for 20 difficult concepts

The resource person delivered the feedback of the workshop

Day -3, Date: 08/03/2019

On the third day, during the first session report of the previous day was presented. In second session the experts were divided into science and mathematics groups. They matched alternative instructional strategies with the content knowledge and listed out appropriate learning activities. In the afternoon session the experts

designed and developed alternative instructional strategies for teaching 40 difficult concepts of the science and mathematics topics from the syllabus of standard IX and X. The draft alternative instructional strategies for teaching difficult concepts in science were presented by a team including Mr. T.Balasubramaniyan, Assistant Professor, M.Kumarasamy college of Education, Karur, S.Karthikeyan, Science Teacher, Govt High School, Ramnad, and Mrs. Noor Afshan, Science Teacher, DMS, RIE Mysore. The draft of the alternative instructional strategies for teaching mathematics difficult concepts was presented by a team consisting of C.G.Elangovan, Lecturer, DIET, Dharmapuri and K.P. Ganesh, Mathematics Teacher, Avvaiyar Govt Girls Higher Secondary School, Dharmapuri. The valedictory function commenced at 4.00 p.m.Dr. V. D. Bhat, Professor, IUCTE, RIE, Mysore, presided over the function and he had distributed certificates to the experts.

Outcome of the Workshop: The Resource Material of "Alternative Instructional Strategies for teaching difficult concepts in Science and Mathematics for teachers and teacher educators."

Appendices

1. List of the Instructional Strategies.
2. List of the difficult concepts in IX and X standard science and Mathematics.
3. Programme Schedule.
4. List of the Participations.
5. The Resource Material on "Alternative Instructional Strategies for teaching difficult concepts in Science and Mathematics for teachers and teacher educators."

The resource person delivered the feedback of the workshop

Prof. V.D. Bhat, IUCTE, RIEM has discussed about the follow-up activities of the workshop

IUCTE Faculty & resource persons photos

Difficult Concepts in IX Science

S.No	Lesson/Topic	Concept
1	Is Matter Around us Pure	1. Suspension 2. Colloidal 3. Effect of Change of Pressure 4. How matter are small
2	Is matter Around us Pure?	Law of Constant properties
3	Atoms and Molecules	Electronic Configuration
4	Structure of the atom	1. Molecular Mass 2. Mole concept
5	The fundamental unit of life	1. Cell membrane cell wall 2. endoplasmic reticulum
6	Tissues	Animal Tissues
7	Diversity in living organism	Classifications of Animals
8	Motion	Equations of motions
9	Force and laws of Motion	Conservation of Momentum
10	Gravitation	1.Thrust and Pressure, 2.Velocity 3.Mass & weight
11	Work and energy	1. Problem and calculation 2. Potential Energy problems
12	Sound	1. Propagation of sound 2. Human ear 3. Characteristics of waves
13	Why do we fall ill	1. Infection disease
14	Natural resources	1. Carbon cycle , 2. Mineral Riches in the soil
15	Improvement in food resources	Nutrient management

Difficult concepts in X Science

S.No	Lesson/Topic	Concept
1	Chemical Reactions and equations	1. Chemical formula 2. Valency 3. Oxidation reduction 4. Balancing the equations
2	Acids, bases and salts	1. Concept of acids, bases 2. Properties of acids and bases 3. Ph, POH
3	Metals and Non metals	Chemical reactions of metals and non-metals
4	Carbon and its compounds	1. Fomula and structure Classifications of carbon and derivatives 2. Homolog series
5.	Periodic classification of elements	To remember the periodic classifications
6.	Life processes	Break down of glucose by various pathway
7.	Control and coordination	Central Nervous system
8.	How do organisms Reproduce	1. Reproduction in human 2. Plant reproduction
9.	Heredity and Evolution	1. Evolution 2. Rules of the inheritance of traits
10	Light-reflection and refraction	1. Lens 2. Images formed by different positions of the object in concave and convex lens
11	The Human eye and the colourful world	Human eye
12.	Electricity	1,Circuit diagram 2,Electrical potential and difference
13	Magnetic Effects of Electric current	Difference between Ac & Dc
14	Source of Energy	Nuclear fission and fusion
15	Our Environment	Ozone layer & how it's getting depleted

Difficult concepts in IX Mathematics

1	**set**	Practical problems on set operation
2	**Real numbers**	Rationalisation of surds
3	**Algebra**	Factorising the quadratic polynomial & trinomial
4	**Geometry**	Properties of chords of a circle
5	**Statistics**	Arithmetic mean-grouped frequency distributions
6	**Probability**	Mutually exclusive event
7	**Coordinate geometry**	Positions of orthocentre and circumcentre
8	**Algebra**	Word Problems based on linear equations in two variables
9	**Mensuration**	Application for the Heron's formula
10	**Algebra**	Consistency and inconsistency of linear equations in two variables

Difficult concepts in X Mathematics

S.No	Lesson/Topic	Difficult Concept
1	**Sets& Functions**	Solving Problem using Venn Diagram
2	**Sequences & Series**	Solving word problem in G.P
3	**Algebra**	Solution of a quadratic equation by completing square
4	**Matrices**	Solving equation
5	**Co-ordinate geometry**	Equation of a straight line
6	**Trigonometry**	Heights and distances
7	**Mensuration**	Combined figures and invariant volumes
8	**Statistics**	Measure of dispersion
9	**Probability**	Addition theorem on probability
10	**Geometry**	Solving word problem using

List of Resource Persons

A Three Day Workshop on

Designing Alternative Instructional Strategies for Teaching Difficult Concepts in Science and Mathematics for Teacher Educators

(6 to 8 March 2019)

Sl.no	Name	Name of the Institution
1	**Dr.Nagavalli**	Associate Professor (Retd.,) Saratha college of Education, Salem, Tamilnadu
2	**Mrs.Vaijayanthi,**	Assistant Professor(SS), Department of Education Avinashilingam University, Coimbatore, Tamilnadu
3	**C.G. Elangovan,**	Lecturer, DIET, Dharmapuri Tamilnadu.
4	**J.Navaneetha Krishnan,**	Assistant Professor Government College of Education,Komarapalayam Namakal(DT), Tamilnadu
5	**Prof. M. S. Talawar**	Center Director, IUCTE, Regional Institute of Education Mysore
6	**Dr.S.Prasannakumar**	Associate professor, IUCTE, Regional Institute of Education Mysore.
7	**Prof. V. D. Bhat**	Professor, IUCTE Regional Institute of Education Mysore

8.	**Dr.A.Divyapriya**	Associate Professor IUCTE, Regional Institute of Education Mysore
9.	**Dr.K. K. Chandini**	Associate Professor IUCTE, Regional Institute of Education Mysore
10.	**Mr. Shravan Kumar Pendyala**	Assistant Professor IUCTE, Regional Institute of Education Mysore
11.	**Mr. Prasanna Kumar T. K.**	Assistant Professor IUCTE, Regional Institute of Education Mysore
12.	**Mr. T.Balasubramanian,**	Assistant Professor, M.Kumarasamy College of Education, Karur.
13.	**Dr. J.Immanuvel johnson,**	Assistant Professor, Sri Ramakrishna Mission vidyalaya College of Education, Coimbatore.
14.	**Mr.ManickasamyAssistant**	Professor, Sri Ramakrishna Mission vidyalaya College of Education Coimbatore**.**
15.	**K.P Ganesh,Avvaiyar**	Govt Hr. Sec. School, Dharmapuri.
16.	**H.Shanawas,**	Graduate Teacher, Govt Model HSS School, Karimangalam, Dharmapuri
17.	**R.Ragothaman,**	Govt High School, Theethipalayam, Coimbatore
18.	**P.M. Rajasekar,B.T**	Assistant (Maths) Govt High School, Barigam, Esalpatti(PO), Dharmapuri

19.	**K.S.A Mohamed Yousuf**	Jainulabuden, Manbaul uloom Hr.Sec. School Coimbatore
20.	**S. Karthikeyan,**	BT Assistant, Govt High School, Elanjemboor, Ramand
21.	**T.MuruliS.A.**	Mathematics ZPHS, Karakambadi Chittoor, Andhra Pradesh
22.	**KMV. Mohan kumarS.A.**	Mathematics, ZPHS, Karakambadi, Chittoor. Andhra Pradesh
23.	**M. SenthilkumarB.T.**	Assistant ,GBHSS, Lakkiyampatti, Dharmapuri
24.	**Divya R. PGT, Mathematics**	DMS, RIE, Mysuru
25	**Mrs. Noor Afshan TGT Science**	DMS, RIE, Mysuru.

Schedule

A Three Day Workshop on
Designing Alternative Instructional Strategies for Teaching Difficult Concepts in Science and Mathematics for Teacher Educators (6 to 8 March 2019)

Day	Date	DATESESSION -1		SESSION - 2	SESSION -3		SESSION - 4		SESSION-5	SESSION- 6
1	06/03/19	9.00-09.30am Registration 9.30-10.00am Inauguration 10.00-10.45am Introduction to Workshop	Tea Time 10.45 to 11.00 am	11.00-12.00 pm Introduction & Designing of Alternative Instructional strategies Dr.Nagavalli & Dr.S.Prasannakumar	12.00-1.00 pm Group Discussion & preparation of lesson format	Lunch 1.00 to 2.00pm	2.00-3.30pm Group work - designing of the strategies	Tea Time 3.30 to 3.45pm	3.45-4.45pm Group work- develop model lesson plan (Ist 10 concepts)	4.45.00- 5.00pm Presentation
2	07/03/19	9.00-9.30am Review &Group Discussion 9.30 - 10.45am Group work-- Writing strategies	Tea Time 10.45 to 11am	11.00- 12.30 pm Group work-- preparation of lesson format (II nd 10 concepts)	12.30-1.00pm Presentation	Lunch 1.00 to 2.00pm	2.00-3.30pm Group work-- design of the strategies (II nd 10 concepts)	Tea Time 3.30 to 3.45pm	3.45-4.45pm Group work-- develop model lesson plan (II nd 10 concepts)	4.45 - 5.00pm Presentation
3	08/03/19	9.00-9.30am Review &Group Discussion 9.30 - 10.45am Group work-- design the learning activities	Tea Time 10.45 to 11am	11.00- 12.00 pm Group work-- design the learning activities	12.00-1.00pm Group work-- format the designing document. (III rd 10 concepts)	Lunch 1.00 to 2.00pm	2.00-3.30pm Group work- format the design document. (III rd 10 concepts)	Tea Time 3.30 to 3.45pm	3.45- 4.15pm Presentation	4.15- 5.00pm Valedictory & Certificate Distribution

Instructional Strategeis

Instructional Strategeis

STRATEGIES	TECHNIQUES /ACTIVITIES
Brainstorming	Brainstorming is a process that allows for the free flow of ideas. A topic/question is introduced and relevant words and phrases are accepted without criticism of judgment. It works to generate a wide variety of ideas. That can they be evaluated as relevant to the subject.
Concept Attainment	It is a teacher centered activity involving the use of critical thinking to determine the critical attributes of a given example of an idea or concept. This indirect process of inquiry leads to the identification of the concept being taught. Before beginning the activity the teacher should determine. 1. The name of the concept 2. The concept definition or rule 3. Conceptual attributes 4. Examples of the concept 5. Relationship of the concept to other concepts **Steps in use concept attainment strategy:** 1. Select and define a concept 2. Select the attributes 3. Develop positive and negative examples 4. Introduce the process to the students 5. Present the examples and list the attributes 6. Develop a concept definition 7. Give additional examples 8. Discuss the process with the class 9. Evaluate

Concept formation	organize and classify items classify items by their characteristics making connection seeing relationships and generalization of the data.
Concepts maps	Web diagram for exploring knowledge about given concept. Central circle – contains the concept being examined; linking ideas are then labelled with lines indicating the connection to the central idea and other links.
Focused imaging/ visualisation	The process of creating mental image
Graphic organizers	A graphic organiser is a visual representation used to visually represent the relationships and patterns between the ideas and facts presented in a lesson.
Role playing	Role playing allows students to take risk-free positions by acting out characters in hypothetical situations. It can help them understand the range of concerns, values and positions held by other people. Role playing is an enlightening and interesting way to help by other. Role playing is an enlightening and interesting way to help students see a problem from another perspective.
Scaffolding	Teacher models the desired learning strategy or task, then gradually shifts responsibility to the students • task definition • model performance while thinking out loud -either direct or indirect instruction • specification and sequencing of activities provide prompts, cues, hints, links, partial solutions, guides and structures • fade when appropriate
Simulations	**Simulation** refers to the imitation of real-world activities and processes in a safe environment. Simulations aim to provide an experience as close to the 'real thing' as possible; however, a simulated activity has the advantage of allowing learners to 'reset' the scenario and try alternative strategies and approaches. This allows learners to develop experience of specific situations by applying their wider learning and knowledge.

Discovery/Inquiry-based learning	Inquiry learning is based on constructivist theories of learning, where knowledge is "constructed" from experience and process. It covers a range of approaches, including: field work, case studies, investigations, individual and group projects, and research projects. It is the hallmark strategy of science, and often social science, learning. Specific learning processes that students engage in during inquiry include: developing questions, seeking evidence to answer questions, explaining evidence, and justifying or laying out an argument for the evidence. Progress and outcomes are assessed through observing students' learning develop over time through conversations, notebook entries, student questions, procedural skills, use of evidence, and other techniques.
Generating and testing hypotheses	At an application level, generating and testing hypotheses requires students to use knowledge to extend their understanding or generate new knowledge. It is a fundamental of science learning, problem solving, and historical investigations. The process can be deductive (starting from a general rule or law) or inductive (drawing a conclusion or generalizing from a set of data or information). Asking students to explain their hypotheses, process, and conclusions, ideally in writing, strengthens student learning and accountability.
Hands-on learning	Hands-on learning is an educational strategy that directly involves learners by encouraging them to do something in order to learn about it. It is learning by doing. Some subject matter like music and art are inherently hands-on; others like higher levels of mathematics are more abstract. Nonetheless, all learning can benefit from activity that stimulates different regions of the brain. For younger learners, those learning English or another language, or those with learning disabilities, thoughtful hands-on teaching strategies are their keys to learning.
Modelling	Modelling is an instructional strategy wherein the teacher or another student demonstrates a new concept or skill and students learn by observing and emulating. Modelling is an effective instructional strategy when it allows students to observe thought processes and imitate particular behaviours or steps in a process. Types and purposes of modelling can include approaches such as task and performance modelling (demonstrating a task), metacognitive modelling (thinking aloud)
Analogy	Analogy is a process of identifying similarities between two concepts. Learners can be introduced to a new concept by relating it with some familiar concept they already possess. 1. Introduce target concept. 2. Cue retrieval of analogy concept. 3. Identify relevant features of target and analogy. 4. Map similarities between target and analogy. 5. Indicate where analogy breaks down. 6. Draw conclusions

Problem solving	• Defining the problem • Analysing the problem • Formulating Hypotheses • Testing of hypotheses • Collecting the data • Interpretation of the data • Finding conclusion
Reciprocal teaching	Reciprocal teaching refers to an instructional activity in which students become the teacher in small group reading sessions. Teachers model, then help students learn to guide group discussions using four strategies: summarizing, question generating, clarifying, and predicting.
Generating and Testing Hypotheses	Ask students to predict what would happen if an aspect of a familiar system, such as the government or transportation, were changed. Ask students to build something using limited resources. This task generates questions and hypotheses about what may or may not work.
Summarizing and Note-taking	This strategy promotes comprehension because students have to analyze what is important and what is not important and put it in their own words. This strategy also Enhances students' ability to synthesize Information and organize it in a way that captures the main ideas and supporting details.
	Sample activities related to this strategy as follow: Provide a set of rules for asking students to summarize a literary selection, a movie clip, a section of a textbook, etc. Provide a basic outline for note-taking, having students fill in pertinent information.

Reinforcing Effort and Providing Recognition	This strategy provides students with a direction for learning and with information about how well they are performing about a particular learning objective so they can improve their performance. Setting objectives can provide students with a direction for their learning. Goals should not be too specific; they should be easily adaptable to students' own objectives. **Sample activities related to this strategy as follow:** Set a core goal for a unit, and then encourage students to personalize that goal by identifying areas of interest to them. Questions like "I want to know" and "I want to know more about…" get students thinking about their interests and actively involved in the goal-setting process. Use contracts to outline the specific goals that students must attain and the grade they will receive if they meet those goals. Make sure feedback is corrective in nature; tell students how they did in relation to specific levels of knowledge. Rubrics are a great way to do this.
Project-based learning Project-based learning: Students independently gather resources and information to create a project and/or product.	• The teacher sets the goals for the learner, and then allows the learner to explore the topic and create their project. • The teacher is a facilitator in this student-cantered approach and provides scaffolding and guidance when necessary. • Proponents of project-based learning cite numerous benefits of these strategies including a greater depth of understanding of concepts, broader knowledge base, improved communication and interpersonal/social skills, enhanced leadership skills, increased creativity, and improved writing skills. • When students use technology as a tool to communicate with others, they take on an active role vs. a passive role of transmitting the information by a teacher, a book, or broadcast. The student is constantly making choices on how to obtain, display, or manipulate information

ALTERNATIVE INSTRUCTIONAL STRATEGIES FOR TEACHING DIFFICULT CONCEPTS IN SCIENCE

Alternative Instructional Strategies for teaching difficult concepts of IX Standard Science

S.No	Contents	Methods	Strategies	Techniques	Teacher's Activities	Student's Activities
1	**MATTER AROUND US PURE** **1.1 Suspension** A suspension is a heterogeneous mixture in which the solute particles do not deserve but remain suspended through all the bulk of the medium. Particles of suspension are visible to the naked eye.	Demonstration	As1. Concept attainment	Illustration	Teacher demonstrates concept of suspensions by mixing sand with water	Students observe the suspended particles and response the teacher's question.
		Questioning	As2. Brainstorming	Critical thinking		
		Discussion	As3. Inquiry based learning	Task designation		
	1.2.Properties of Suspension The particles of a suspension scatter a beam of light passing through it and make its path visible. • The solute particles settle down when a suspension is left undisturbed, that is, a suspension is unstable. They can be separated from the mixture by the process of filtration. When the particles settle down, the suspension breaks and it does not scatter light any more.	Demonstration	As1. Direct Instruction	Explaining	Critically making the students to analyse	Students infer to share the knowledge
		Experimental	AS2. Hands on learning	Procedural knowledge		

	1.3. Colloids The particles of a colloid are uniformly spread throughout the solution. Due to the relatively smaller size of particles, as compared to that of a suspension, the mixture appears to	Discussion Problem solving	AS1. Concept attainment AS2. Interactive Instruction	Illustrations Group activity	Teacher gives simulated package	Observe the simulations
	be homogeneous. But actually, a colloidal solution is a heterogeneous mixture, for example, milk. Tyndall effect can also be observed when a fine beam of light enters a room through a small hole. This happens due to the scattering of light by the particles of dust and smoke in the air. Tyndall effect can be observed when sunlight passes through the canopy of a dense forest. **Properties of a Colloid** The size of particles of a colloid is too small to be individually seen by naked eyes. They do not settle down when left undisturbed, that is, a colloid is quite stable.					

	1.4. Effect of change of pressure Air is a homogeneous mixture and can be separated into its components by fractional distillation. If we want oxygen gas from air, we have to separate out all the other gases present in the air. The air is compressed by increasing the pressure and is then cooled by decreasing the temperature to get loquitur. This liquid air is allowed to warm-up slowly in a fractional distillation column, where gases get separated at different heights depending upon their boiling points.	Laboratory	AS:1 Reflective thinking	Learning by doing	Teacher facilitating the experiment	Realising the concept
		Demonstration	AS:2 Brainstorming	Questioning		
	1.5. How matter are small On the basis of their chemical composition, substances can be classified either as elements or compounds.	Bio graphical	As1. Inquiry	Illustration.		

	Elements Robert Boyle was the first scientist to use the term element in 1661. Antoine Laurent Lavoisier (1743-94), a French chemist, was the first to establish an experimentally useful definite down into simpler substances by chemical reactions. Compounds have fixed composition can be broke down into elements by chemical or electro chemical reactions. For eg, Water, methane, sugar, salt etc. Pure substances can be elements or compounds. An element is a form of matter that cannot be broken down by chemical reactions into simpler substances. A compound is a substance composed of two or more different types of elements, chemically combined in a fixed proportion.	Historical	As2. Brain storming	Questioning	Teacher explains the how matter become small substance.	Students understand the how matter is small.
		Demonstration	As3: Discussion	Interaction		

<table>
<tr><td rowspan="2">2.</td><td rowspan="2">2.1 Law of Constant properties
Properties of a compound are different from its constituent elements, whereas a mixture shows the properties of its constituting elements or compounds.</td><td>Analytical</td><td>AS:1 Concept formation</td><td>Group Discussion</td><td rowspan="2">Summarizing</td><td rowspan="2">Observing</td></tr>
<tr><td>Explaining</td><td>As2: Concept formation</td><td>Generalizations</td></tr>
<tr><td rowspan="3">3.</td><td rowspan="3">3. STRUCTURE OF THE ATOM
3.1 Molecular Mass
The molecular mass of a substance is the sum of the atomic masses of all the atoms in a molecule of the substance.
(a) Calculate the relative molecular mass of water (H_2O).
(b) Calculate the molecular mass of HNO_3

Solution:
(a) Atomic mass of hydrogen = 1u, oxygen = 16 u
So the molecular mass of water, which contains two atoms of hydrogen and onetime of oxygen is</td><td>Deductive</td><td>AS1: Problem solving</td><td>Minds on training</td><td rowspan="3">Teacher explain in detail the molecular mass with help of visualization</td><td rowspan="3">The students understand the molecular mass and its calculation.</td></tr>
<tr><td>Activity</td><td>As2:Drill and Practice</td><td>Hands on experience</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

	= 2 × 1+ 1×16= 18 u (b) The molecular mass of HNO3 = the atomic mass of H + the atomic mass of N+ 3 × the atomic mass of O = 1 + 14 + 48 = 63 u					
	3.2 Mole concept One mole of any species (atoms, molecules, ions or particles) is that quantity in number having a mass equal to its atomic or molecular mass in grams. 1 mole = 6.022×10^{23} number	Inductive Demonstration Discussion	AS1.Focus Imaging AS2.Concept formation AS3.Concept attainment	Hypothetical Learning Generalization Inquiry	Questioning and Explaining	Model preparation
4.	**4. ATOMS AND MOLECULES** **4.1 Electronic Configuration** The distribution of electrons into different orbits of an atom was suggested by Bohr and Bury. The following rules are followed for writing the number of electrons in different energy levels or shells: (I) The maximum number of electrons present in a shell is given by the formula 2n2, where 'n' is the orbit number or energy level index, 1,2,3,….Hence the maximum number ofelectrons in different shells are	Group activity Explaining Multimedia Demonstration	AS1.Collabrative learning AS2.Simulation As3. Modelling	Role play Visuospatial Multisensory	Teacher provides learning environment for experiential learning	Students actively participate and understand the concept.

	as follows: first orbit or K-shell will be = 2×12=2, second orbit or L-shell will be=2×22= 8, third orbit or M-shell will be =2×32=18, fourth orbit or N-shell will be =2×42=32, and so on. (ii) The maximum number of electrons that can be accommodated in the outermost orbit is 8. (iii) Electrons are not accommodated in agiven shell, unless the inner shells are Filled. That is, the shells are filled in a step-wise manner.					
5	**5. THE FUNDAMENTAL UNIT OF LIFE** **5.1 Cell wall and Cell membrane** Cell wall is the outermost covering of the cell in plants that separates the contents of the cell from its external environment. The plasma membrane allows or permits the entry and exit of some materials in and out of the cell. It also prevents movement of some other materials.	Demonstration Visualizations	AS1.Focused Imaging AS2.Simulations	Modelling Memory	Teacher explains and demonstrates cells and its organelles.	Observes the process of osmosis through the experiment and draw the diagram and labels.

	The cell membrane, therefore, is called a selectively permeable membrane. Osmosis and diffusion are the physical phenomenon happened in the cell membrane. i.e., the exchange of gases and water.					
	5.2 Endoplasmic Reticulum The endoplasmic reticulum (ER) is a large network of membrane-bound tubes and sheets. It looks like long tubules or round or oblong bags (vesicles). The ER membrane is similar in structure to the plasma membrane. There are two types of ER - rough endoplasmic reticulum (RER) and smooth endoplasmic reticulum (SER). ER is to serve as channels for the transport of materials(especially proteins) between various regions of the cytoplasm or between the cytoplasm and the nucleus.	Discussion	AS1.Modeling	Improvised Apparatus	With the help of a diagram teacher list out the difference between rough and smooth ER	Understands the differences of rough and smooth ER.
		Heuristic	AS2.Concept mapping	Sensory Techniques		

6	**6. TISSUES** **6.1 Animal Tissues** A group of cells collectively called as tissue. In animal, the specialized cells called muscle cell. There are four types of tissues in animal. They are Epithelial tissue, Connective tissue, Muscular tissue and Nervous tissue.	Demonstration	AS1.Concept mapping	Illustration	With the help of concept map teacher and slide presentation and summarizing concept of animal tissues.	Observes and differentiates between different types of tissues and its function.
		Discussion	AS2.Concept attainment	Differentiation		
		Visualization	AS3.Simulation	Visuospatial		
7	**7. DIVERSITY IN LIVING ORGANISM** **7.1 Classification of Animals** The identification and naming of animal species in an organized manner which we call it as classification. The classification is done by naming the sub-groups at various levels as given in the following scheme: (i) Kingdom (ii) Phylum (for animals) (iii) Class (iv) Order (v) Family (vi) Genus (vii) Species	Explaining	AS1.Concept mapping	Similarities and differences	Make a field trip and displays the specimens and shows to the students in the laboratory.	Students observe and record the activities. And discuss in groups the diversity of phylum.
		Historical method	As2. Scaffolding	Illustrations		
		Field visit	As3 Observation	Direct experience		
		Demonstration	As 4 :Modelling	Visualization		

8	**8. MOTION** **8.1 Equations of motion** Graphs provide a convenient method to present basic information about a variety of events. To describe the motion of an object, we can use line graphs. In this case, line graphs show dependence of one physical quantity, such as distance or velocity, on another quantity, such as time. DISTANCE - TIME GRAPHS VELOCITY - TIME GRAPHS	Deductive and inductive	AS1.Problem solving	Inquiry learning	Teacher shows plotting of graphs explains steps involved in plotting	Students observe to draw and label the graph. Student plotting graphs for different values of distance and time. They able to compare Distance - Time, Velocity - Time graph.
		Activity	AS2. Hands on training	Procedural Memory		
	8.2 Equations of Motion by Graphical Method When an object moves along a straight line with uniform acceleration, it is possible to relate its velocity, acceleration during motion and the distance covered by it in a certain time interval by a set of equations known					

	as the equations of motion. For convenience, a set of three such equations are given below: $v = u + at$ (8.5) $s = ut + \frac{1}{2} at^2$ (8.6) $2as = v^2 - u^2$ (8.7) where u is the initial velocity of the object which moves with uniform acceleration a for time t, v is the final velocity, and s is the distance travelled by the object in time t. Eq. (8.5) describes the velocity-time relation and Eq. (8.6) represents the position-timerelation. Eq. (8.7), which represents the relation between the position and the velocity, can be obtained from Eqs. (8.5) and (8.6) by eliminating t. These three equations can be derived by graphical method	Visualization	As3. Mapping	Mnemonics		

9	**9. FORCE AND LAWS OF MOTION** **9.1 Conservation of momentum** Suppose two objects (two balls A and B, say)of masses m_A and m_B are travelling in the same direction along a straight line at different velocities u_A and u_B, respectively. And there are no other external unbalanced forces acting on them. Let $v_A > v_B$ and the two balls collide with each other. During collision which lasts fora time t, the ball A exerts a force F_{AB} on ball Band the ball B exerts a force F_{BA} on ball A. Suppose v_A and v_B are the velocities of the two balls A and B after the collision, Respectively. As a result of this ideal collision experiment, we say that the sum of momenta of the two objects before collision is equal to the sum of momenta after the collision provided there is no external un balanced force acting on them. This is known as.	Demonstration	AS1.Simulation	Illustration	The teacher explains and using models and derives equation relevant to the conservation of momentum.	Students observe and understand the concept of conservation of momentum.
		Experimentation	AS2.Hands on learning	Learning by doing		

	the law of conservation of momentum. This statement can alternatively be given as the total momentum of the two objects is unchanged or conserved by the collision					
10	**10. NATURAL RESOURCES** **10.1 Carbon cycle** Carbon is found in various forms on the Earth. It occurs in the elemental form as diamonds and graphite. In the combined state, it is found as carbon dioxide in the atmosphere, as carbonate and hydrogen carbonate salts in various minerals, while all life -forms are based on carbon-containingmolecules like proteins, carbohydrates, fats. Nitrogen-cycle in nature nucleic acids and vitamins. The endoskeleton sand exoskeletons of various animals are also formed from carbonate salts. Carbon is incorporated into life-forms through the basic process of photosynthesis which is performed in the presence of Sunlight by all life-forms that contain chlorophyll. Carbon is thus cycled repeatedly through different forms by the various physical and biological activities.	Demonstration Discussion Interactive	AS1.Concept mapping AS2.Concept attainment AS3.Inquiry based learning	Explaining Questioning Reflective discussion	Teacher show the chart and explain the concept.	Students make Inquiry question and understand the concept.

Alternative Instructional Strategies for teaching difficult concepts of X Standard Science

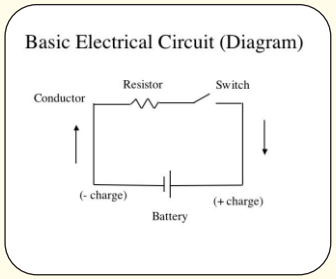
S.No	Contents	Methods	Strategies	Techniques	Teacher's Activities	Student's Activities
1	**1.CHEMICAL REACTIONS AND EQUATION** **1.1.Chemical formula** Chemical equations can be made more concise and useful if we use chemical formulae instead of words. A chemical equation represents a chemical reaction. **Balanced Chemical Equations** The total mass of the elements present in the products of a chemical Reaction has to be equal to the total mass of the elements present in the reactants. Is the following chemical equation balanced? The word-equation for Activity represented as – Zinc+Sulphuric acid → Zinc sulphate + Hydrogen The above word-equation represented by the following chemical equation – $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$	Brainstorming	AS1. Focused imaging	Visuospatial	Teacher presents with pictorial representation Encouraging Students to share their thoughts.	Students' active participate. Students discuss with in the group. Observation
		Problem solving	AS2. Visualization	Visual image		
		Questioning	As3. Hands on training	Drill and practice		
		Discussion	As4. Collaborative learning	Gaming		

	1.2. Oxidation and Reduction If a substance gains oxygen or loses hydrogen during a reaction, it is oxidised. If a substance loses oxygen or gains hydrogen during a reaction, it is reduced. Oxygen is added to copper and copper oxide is formed. Heat $2Cu + O_2 \rightarrow 2CuO$ If hydrogen gas is passed over this heated material (CuO), the black coating on the surface turns brown as the reverse reaction takes place and copper is obtained. Heat $CuO + H_2 \rightarrow Cu + H_2O$ The examples of redox reactions are: $ZnO + C \rightarrow Zn + CO$ $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$ In reaction carbon is oxidised to CO and ZnO is reduced to Zn. In reaction HCl is oxidised to Cl_2 whereas MnO_2 is reduced to $MnCl_2$.	Demonstration	AS1.Direct instruction	Illustration	Teacher demonstrates the concept of oxidation and reduction	Students observes the activity
		Problem solving	AS2. Visualization	Interaction		
		Discussion	AS3.Focused imaging	Visuospatial		
		Deductive	AS4 : Problem solving	Interactions		

2	**2.ACIDS BASES AND SALTS** **2.1.Concepts of acids, bases** Acids are sour in taste and change the colour of blue litmus to red, whereas, bases are bitter and change the colour of the red litmus to blue. Litmus is a natural indicator, turmeric is another such indicator.	Discussion	AS1.Concept attainment	Classifies	Teacher Illustrates and explains the content of acids and bases.	Students recall and recognize the concept of acid and base.
		Demonstration	AS2.Concept formation	Relationships		
	2.2.Properties of acids and bases These indicators tell us whether a substance is acidic or basic by change in colour. There are some substances whose odour changes in acidic or basic media. These are called olfactory indicators.	Laboratory	AS1.Hands on training	Procedural Memory	Teacher explain the concept through the laboratory environment	Students observe the experiment and record the observation.
		Inquiry	AS2.Problem solving	Reflective thinking		
	2.3. pH and pOH How strong are acid or base solutions? Importance of pH in Everyday Life Importance of pH in Everyday Life	Questioning	As1. Brainstorming	Mnemonics	Teacher explains, demonstrates and summarizes relevant to pH	Student records the observation and actively participate in classroom.
		Problem solving	AS2. Formulation of Hypothesis	Interpretation		
		Project method	As3. Demonstration	Testing and Identification		
		Concept Map	As4. Visualization	Visuospatial		

3	**CARBON AND ITS COMPOUNDS** **3.1.Formula, structure Classification of carbon and derivatives**	Explaining Structured over view Discussion	As1. Role playing As2. Visualization As3. Stimulation	Drill practice Visual image, perception, Memory	Teacher presents pictorial representation	Students actively participate.
	3.2. Homolog Series Carbon atoms can be linked together to form chains of varying lengths. These chains can be branched also. In addition, hydrogen atom or other atoms on these carbon chains can be replaced by any of the functional groups that we saw above. The presence of a functional group such as alcohol decides the properties of the carbon compound, regardless of the length of the carbon chain. For example, the chemical properties of CH3OH, C2H5OH, C3H7OH and C4H9OH are all very similar. Hence, such a series of compounds in which the same functional group substitutes for hydrogen in a carbon chain is called a homologous series.	Explaining Discussion	AS1. Concept formation AS2. Concept mapping	Reflective Thinking Association (Finding relationship)	Teaching explains the concept in detail with the help of pictorial representation	Student prepare mind map.

4	**4.LIGHT REFLECTION AND REFRACTIONS** **4.1 Lens**	Explaining	As1. Brain storming	Classifies/ Clarifies / Discriminates	Teacher explains the type of lens and its basic concept	Student realizes the basic concept of lenses.
	4.2 Images formed by different positions of the object in concave and convex lens.	Demonstration	AS2.Hands on training	Drill and practice		
		Laboratory Method	AS3.Problem solving	Manipulation Interpretation		
		Visualization	As 4. Multimedia assisted teaching	Attention, Memory		
5	**5.ELECTRICITY** **5.1Circuit Diagram** If the electric charge flows through a conductor (for example, through a metallic wire), we say that there is an electric current in the conductor. In a torch, we know that the cells (or a battery, when placed in proper order) provide flow of charges or an electric current through the torch bulb to glow. We have also seen that the torch gives light only when its switch is *on*. What does a switch do? A switch	Demonstration	As1. Visualization	Visual attention Iconic memory	Demonstrates & explains the formation of circuit diagram	Observes and understands circuit diagrams
		Laboratory method	AS2.Learning by doing	Hands on training		

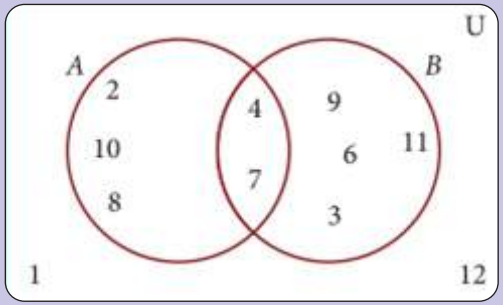
	makes a conducting link between the cell and the bulb. A continuous and closed path of an electric current is called an electric circuit.  					
	5.2.Electrical potential and difference	Demonstration	AS1.Concept formation	Explaining	Teacher demonstrates and explain the electrical potential and difference	Student observes, analyze the electrical potential difference through hands on training with graphical representation.
		Experimental	AS2.Learning by doing	Collaborative learning		
		Laboratory	As3.Hands on learning	Procedural Experience		
		Visualizations	AS4.Graphical representation	Imagery		

6	**6.MAGNETIC EFFECT OF ELECTRIC CURRENT** **6.1 Difference between AC & DC**	Demonstration	AS1.Concept Attainment	Discussion	Teacher explains and differentiates	Students recognize the concept of
7	**LIFE PROCESS** **7.1. Breakdown of glucose by various pathway** The first step is the break-down of glucose, a six-carbon molecule, into a three-carbon molecule called pyruvate. This process takes place in the cytoplasm. Further, the pyruvate may be converted into ethanol and carbon dioxide. This process takes place in yeast during fermentation. Since this process takes place in the absence of air (oxygen), it is called anaerobic respiration. Break down of pyruvate using oxygen takes place in the mitochondria. This process breaks up the three-carbon pyruvate molecule to give three molecules of carbon dioxide. The other product is water. Since this process takes place in the presence of air (oxygen), it is called aerobic respiration	Laboratory	AS2.Inquiry	Problem solving	AC and DC motor	differences of AC and DC electric current.
		Explaining	AS3.Simulation	Focused imaging		
		Demonstration	AS1.Simulation	Inquiry	Demonstrates Anaerobic respiration. Explains the concept Teacher explains aerobic respiration.	Observes and records the reaction students from the mind map for aerobic respiration. Using the flowchart to show the breakdown of glucose into Co2, H2o & energy
		Discussion	AS3.Concept formation	Observation		
		Visualizations	AS4: Concept Mapping	Web diagram Flowchart		

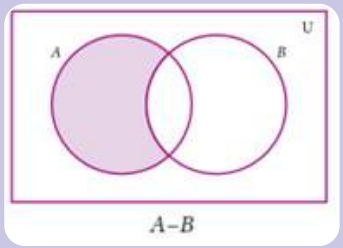
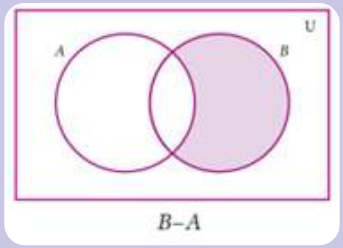
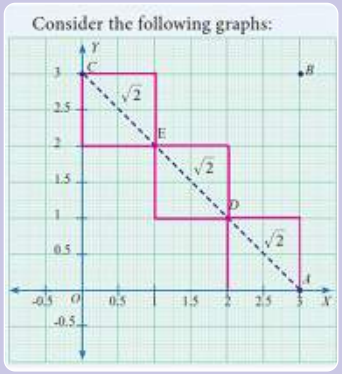
8	**8.HEREDITY AND EVOLUTION** **8.1 Evolution**	Historical	AS1: Brainstorming	Questioning	Teacher explains the historical evidences of evolution. Teacher elucidates the different concepts in evolution.	Students observe and recognize the historical events. Students draw the mind map for the stage of evolution
		Biographical Method	AS2:Concept attainment	Web diagram		
		Discussion	AS3: Inquiry learning	Comparative & Discriminative learning		
		Explaining	As4: Analogy	Discussions		
9	**9.OUR ENVIRONMENT** **9.1 Ozone layer and how it's getting depleted**	Discovery	As1: Brainstorming	Questioning	Explains the importance of ozone in our environment. Teacher uses concept maps to summarizing the importance of the ozone	Students observe and recognize the pollutant that causes depletion of ozone. Students uses mind map to understand the concepts
		Explaining	As2: Summarizing and note taking	Concept mapping		

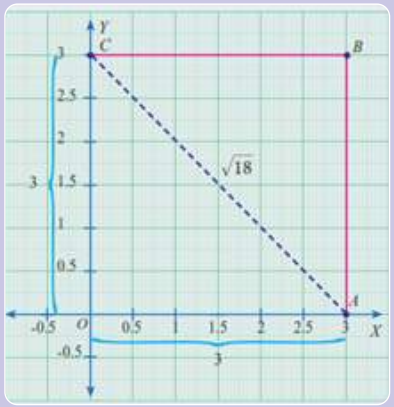
ALTERNATIVE INSTRUCTIONAL STRATEGIES FOR TEACHING DIFFICULT CONCEPTS IN MATHEMATICS

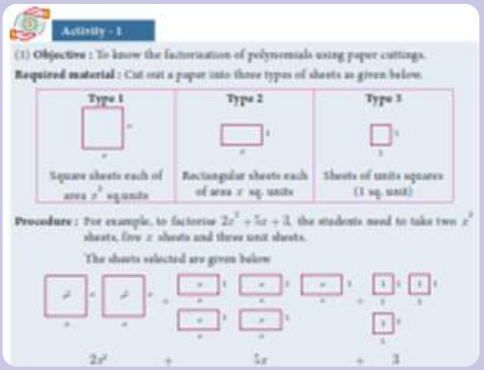
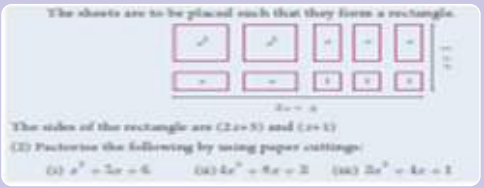
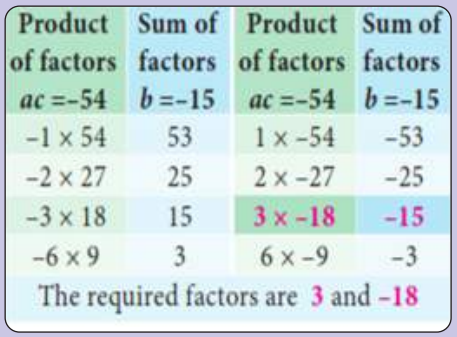
Alternative Instructional Strategies for teaching difficult concepts of IX Standard Mathematics

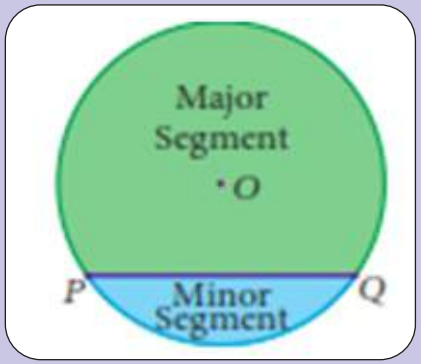
S.No	SUB CONCEPT / CONTENT (1)	Methods (2)	Strategies (3)	Techniques (4)	Teacher's Activities (5)	Student's Activities (6)
1	**SET / Practical Problems on Set Operations** 	As1 Demonstration	Brainstorming	Questioning	Poses questions to make the concept clear in a sequential order	Share their ideas on the operations of sets and explain their views
		AS2 Direct instruction	Inquiry based Learning	Investigation	Presents advanced organizers and questions on operators of sets	Critically think and answer the questions
		AS3 Concept mapping	Concept attainment	Explains the relationship of the set operators	Cites examples and defines the task Draws the concept map	Classify the attributes of set operations draws mind maps
		AS:4 Visualisation	Diagrammatic representation	Using Venn diagram model kit	Uses model kits and explains Venn diagram	Absorb the demonstration and represent the problem with Venn diagram

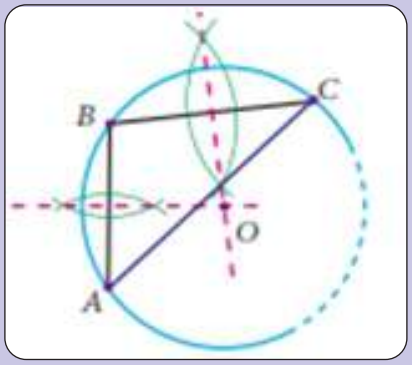
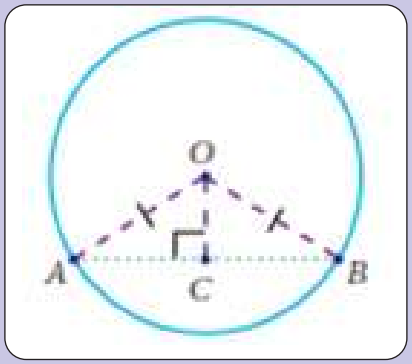
find,

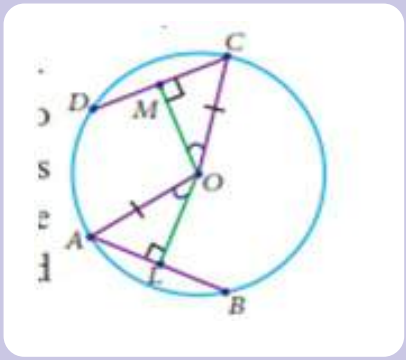
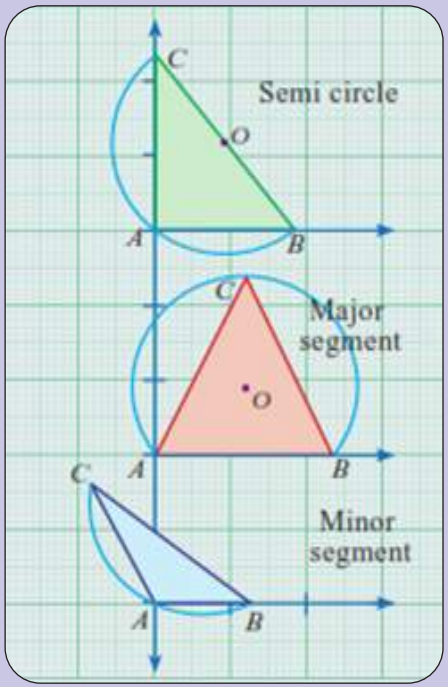
	(I) A (ii)B (iii)B ∪ B (iv) A ∩ B *(V) A-B (vi)B-A (vii)A' (viii)B'* *(ix)U*  *A–B*  *B–A*					
2	**Real Numbers /** Rationalisation of Surds  $AC = 3\sqrt{2}$ units	AS1 Direct Instruction	Concept Formation	Relationships	Gives examples and explain the concept surds	Classify the attributes of surds

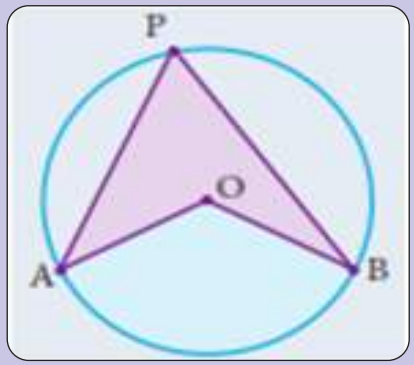
	 $AC = \sqrt{18}$ units HENCE AC = $3\sqrt{2} = \sqrt{18}$ Rationalize the denominator $1/\sqrt{2}$, $1/\sqrt{3}$, $1/(\sqrt{3}+\sqrt{2})$	AS2 Drill and Practice	Hands on learning	Explanation	Explain the steps in rationalization of surds	Solve problems on rationalization of surds
	Identify Surds ? (i) $\sqrt{36}$, $\sqrt{\frac{50}{98}}$, $\sqrt{1}$, $\sqrt{1.44}$, $\sqrt[3]{32}$, $\sqrt{120}$ (ii) $\sqrt{7}$, $\sqrt{48}$, $\sqrt[3]{36}$, $\sqrt{5}+\sqrt{3}$, $\sqrt{1.21}$, $\sqrt{\frac{1}{10}}$	As3 Classification Method	Concept attainment	Various Examples	Examples and non examples and make the students to identity the surds	Apply the attributes of surds to solve problems

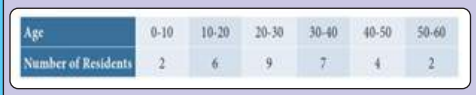
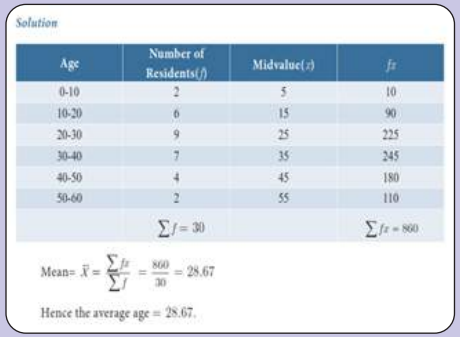
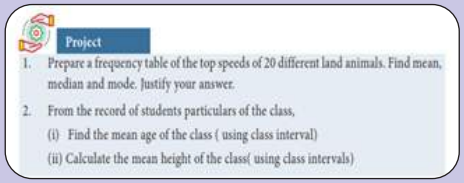
<table>
<tr>
<td rowspan="2">3</td>
<td rowspan="2">Algebra /
Factorizing the quadratic polynomial & trinomial/
 
 
 
<table>
<tr><th>Product of factors $ac = -54$</th><th>Sum of factors $b = -15$</th><th>Product of factors $ac = -54$</th><th>Sum of factors $b = -15$</th></tr>
<tr><td>-1×54</td><td>53</td><td>1×-54</td><td>-53</td></tr>
<tr><td>-2×27</td><td>25</td><td>2×-27</td><td>-25</td></tr>
<tr><td>-3×18</td><td>15</td><td>3×-18</td><td>-15</td></tr>
<tr><td>-6×9</td><td>3</td><td>6×-9</td><td>-3</td></tr>
<tr><td colspan="4">The required factors are 3 and -18</td></tr>
</table>
</td>
<td>As1 Learning by doing</td>
<td>Project based</td>
<td>Using Algebraic Tiles</td>
<td>Explain step by step the method of using algebraic tiles to factorize quadratic polynomial</td>
<td>Observe the demonstration by the teacher and learns to use algebraic tiles to factorize the quadratic polynomials</td>
</tr>
<tr>
<td>AS2 Demonstration Method</td>
<td>Modelling</td>
<td>Performance (Using thinking)</td>
<td>Creates the situation that stimulate the students to find the method of factorizing</td>
<td>Share their ideas and perceptions on factorizing the quadratic polynomial</td>
</tr>
</table>

	$2x^2 - 15x - 27 = 2x^2 - 18x + 3x - 27$ $= 2x(x-9) + 3(x-9)$ $= (x-9)(2x+3)$ Therefore, $(x-9)$ and $(2x+3)$ are the factors of $2x^2 - 15x - 27$	As3 Direct Instruction Method	Reinforcing efforts	Questioning	Ask questions to check the level of understanding of the students in factorizing trinomials	Answer the questions post by the teacher
4	**Geometry /** Properties of Chord of a circle  	As1 Inquiry method	Concept attainment	Questioning	Ask questions to the students to elicit the properties of chords of a circle and Summarizes the properties	Analysis the properties of chord Syntheses the properties

	 There is one and only one circle passing through three non collinear points.  The perpendicular from the centre of a circle to a chord bisect the chord	As2 Demonstration Method	Modelling	Performance Modelling (Demonstration)	Explains the properties of chords and state the theorems based on properties using cutout of circles	Workout with cutouts and discover the properties of chords and understands the theorems based on properties

	 Equal chords of a circle are equidistant from the centre. 	As3 Problem solving	Focused imaging	Hands on training	Using geo board traces circles with thread/wool ect and create real situations for experimentation	Infer the properties of chords of the circle and summarises

	The angle subtended by an arc of the circle at the centre is double the angle subtended by it at any point on the remaining part of the circle.  9. A school wants to conduct tree plantation programme. For this a teacher allotted a circle of radius 6m ground to nineth standard students for planting sapplings. Four students plant trees at the points A, B, C and D as shown in figure. Here AB = 8m, CD = 10m and $AB \perp CD$. If another student places a flower pot at the point P, the intersection of AB and CD, then find the distance from the centre to P.					
5	**Statistics / Arithmetic Mean (Grouped frequency distribution)** The following data gives the number of residents in an area based on their age. Lets find the average Age	As1 Direct instruction	Concept formation	Task definition	Explain the direct method of calculating arithmetic mean	make connections between the steps in calculating arithmetic mean using direct method

	  					
		As2 Learning by doing	Project Method	Collecting and grouping data	Gives projects to collect data and tabulate appropriately	Collect data and frame frequency table
6	**Probability /** Mutually exclusive Event  Random experiment :Flipping a coin Sample space : S={H,T} A={H} B={T} A and B are mutually exclusive events.	AS1 Demonstration Method	Concept formation	Activities based on day to day life (Real life)	Demonstrates with coins, balls, playing cards etc and explains mutually exclusive events	Observe the class and gives their own examples
		AS2 Inquiry method	Concept attainment	Task definitions	Explains the definition of mutually exclusive events and apply the	Solve problems on addition theorem of probability and understands the

Age	0-10	10-20	20-30	30-40	40-50	50-60
Number of Residents	2	6	9	7	4	2

Solution

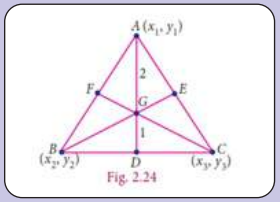
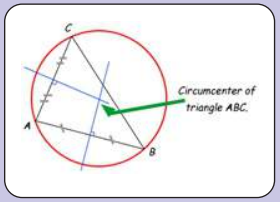
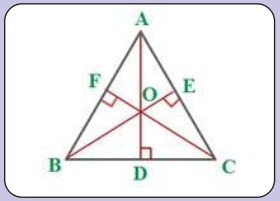
Age	Number of Residents(f)	Midvalue(x)	fx
0-10	2	5	10
10-20	6	15	90
20-30	9	25	225
30-40	7	35	245
40-50	4	45	180
50-60	2	55	110
	$\sum f = 30$		$\sum fx = 860$

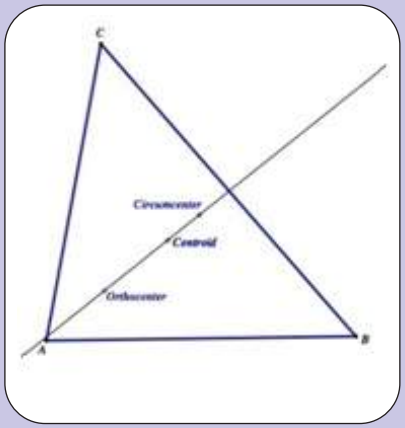
Mean= $\bar{X} = \frac{\sum fx}{\sum f} = \frac{860}{30} = 28.67$

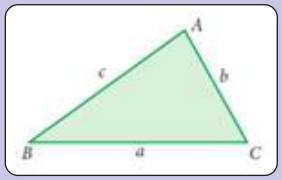
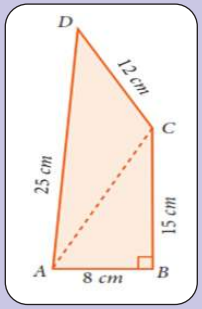
Hence the average age = 28.67.

Project

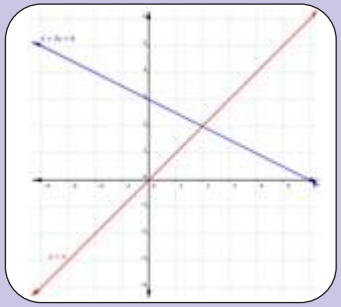
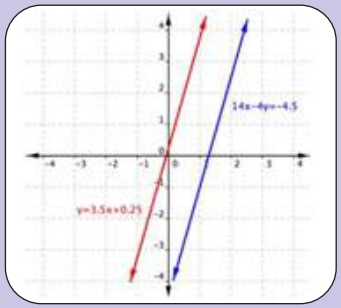
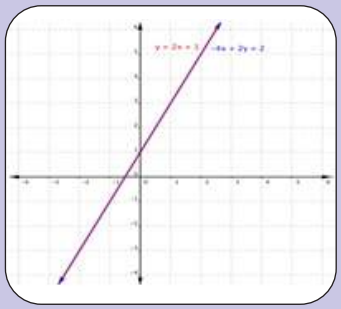
1. Prepare a frequency table of the top speeds of 20 different land animals. Find mean, median and mode. Justify your answer.
2. From the record of students particulars of the class,
   (i) Find the mean age of the class (using class interval)
   (ii) Calculate the mean height of the class(using class intervals)

	 An urn contains 4 red balls and 6 blue balls. What is probability of choosing a red ball?				addition theorem of probability	mutually exclusive events.
7	**Co ordinate geometry** Positions of ortho center centroid and circum centre  Fig. 2.24  	As1 Learning by doing	Visuospatial	Tactile memory and perception	Explains rthocenter, centroid, circumcentre by paper folding method	Observes the teacher and learns the positions of these three centers

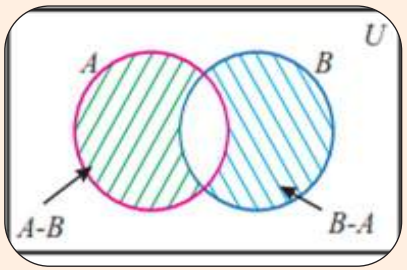
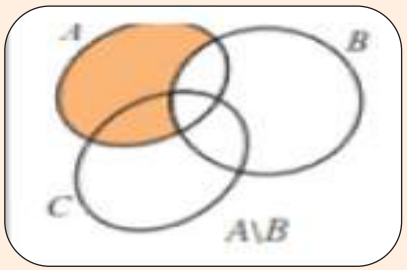
		As2 Direct instruction	Concept attainment	Task definition	Defines the orthocenter, centroid, circumcenter of a triangle	Understands the definitions of the three centers
		As3 Drill and practice	Problem solving	Explanation	Explain the Euler line of triangle and solves problems	Solve the problems on centroid and other centers
8	**Algebra** Word problems based on linear equations in two variables Akshya has 2 rupee coinsand 5 rupee coins of in hr purse, if in all she has 80 coins totalling Rs. 220, how many coins of each kind does she have X+Y=80 2X+5Y=220	As1 Discovery	Collaborative learning	Group work	Explains the most appropriate method of solving linear equations in two variables	Solves the linear equation in two variables

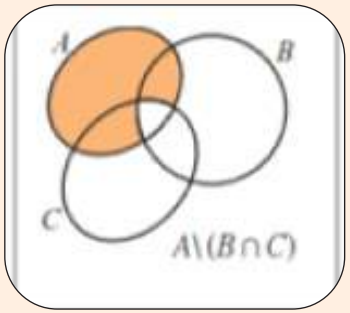
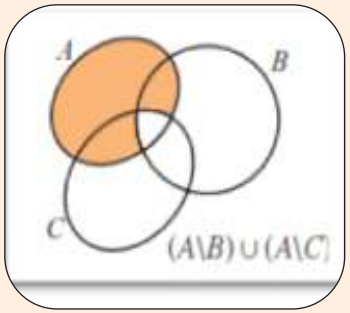
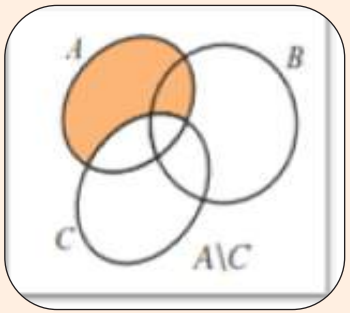
	Tharun's mother is 28 years older than tharun. Tharun's mother is 4 years younger than tharun father. Their total age is 84 years. What is the age of his mother? Tharun's age x □ mother's age x+28 □□ Father's age x+28+4 □□□	AS2 observation	Concept formations	Classify the variables	Guides and structures the equations	Frames linear equations and solves it
9	**Mensuration** Application of Heron's formula  If a, b and c are the sides of a triangle, then the area of a triangle $=\sqrt{s(s-a)(s-b)(s-c)}$ sq.units. where $s=\frac{a+b+c}{2}$, 's' is the semi-perimeter (that is half of the perimeter) of the triangle.  	As1 Task definition	Concept attainment	Classifies conceptual attributes	Explains the Heron's formula for finding the area of a scalene triangle	Applying the Heron's Formula and solves it
		AS2 deduction	Analogy	Cue retrieval	Explains the method of folding the right angled quadrilateral to get two triangles using cutouts of right-angled quadrilateral	Identifies two triangles as one right angled triangle and the other the scalene triangle

	Area of $\Delta ABC = \frac{1}{2} \times \text{base} \times \text{height}$ $= \frac{1}{2} \times 8 \times 15 = 60\ cm^2$ By Pythagoras theorem, in right angled triangle ABC, $AC^2 = AB^2 + BC^2$ $= 8^2 + 15^2 = 64 + 225 = 289\ cm$ Therefore, $AC = \sqrt{289} = 17cm$ $s = \frac{a+b+c}{2} = \frac{17+12+25}{2} = \frac{54}{2} = 27\ cm$ Area of $\Delta ACD = \sqrt{s(s-a)(s-b)(s-c)}$ $= \sqrt{27(27-17)(27-12)(27-25)}$ $= \sqrt{27 \times 10 \times 15 \times 2}$ $= \sqrt{3 \times 3 \times 3 \times 2 \times 5 \times 5 \times 3 \times 2}$ $= 3 \times 3 \times 2 \times 5 = 90cm^2$	AS3 Synthetic method	Problem solving	Deduction	Explains the steps in find the area of triangles and there by the area of the quadrilateral	Find the area of the scalene triangle using Heron's formula. Find the area of the quadrilateral
10	**Consistency and inconsistency of linear equations in two variables** Compare the ratios / Graphical representation / Algebraic interpretation $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ — Intersecting lines — Unique solution $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$ — Coinciding lines — Infinite many solutions $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ — Parallel lines — No solution	As1 Visualization	Graphic organizers	Visual imagery	Explains the conditions to find the consistency and inconsistency of linear equations using graphic organizers	Visualizes the conditions to find the consistency and inconsistency of linear equations

	  	As2 Concept map	Concept formation	Classifies consistent and inconsistent equations	Draws concept map and explains the attributes of consistent and inconsistent equations	Draws mind map for the conditions to find the consistency and inconsistency of linear equations

Alternative Instructional Strategies for teaching difficult concepts of X Standard Mathematics

S.No.	SUB CONCEPT / CONTENT (1)	METHODS (2)	STRATEGIES (3)	TECHNIQUES (4)	TEACHER'S ACTIVITIES (5)	STUDENT'S ACTIVITES (6)
1	**SET /** Solving problems using Venn Diagram   	**As1** Demonstration method	Concept attainment	Critical thinking	Teacher demonstrates the Commutative property, Associate property , Distributive property and De Morgan laws by using Chart or Ariel kit model 1. Teacher explain A-B & B-A 2. Teacher explain A/B	Students learns the concept by applying the property one by one 1. Student learn A-B & B-A 2. Student able to do B/A

	   Teacher instruct using the website URL code https://youtube/tyDKR4FG3Yw Students learns through QR code given in the text bookSequence and Series /	**AS 2** Direct instruction method	Concept Mapping	Web diagram for exploring knowledge about given concept	3. Teacher explain (A/B) U (A/C)	3. Student learn (A/B) U (A/C)
		AS3:Learning by doing	Visuospatial	Hands on learning	4. Teacher explain A/C Teacher instructs the properties by using ICT	2. Student able to do B/C & C/A I) Students understand the concept through application of technology ii) Students understand the content through QR code

2	**Sequence and Series/ Solving word problems in AP and GP** Ex : 1. In a flower garden , there are 23 rose plants in first row , 21 in second row , 19 in third row and so on. There are five rose plants in last row. 2. The number of bacteria in a certain culture doubles every hour. If there were 30 bacteria present in the culture initaily. a,a+d+,a2d,...., a+(n-1)d... $a.ar,ar^2,....,ar^{n-1}$, Ex: 1. If a person joins his work in 2010 with an annual salary of Rs.30000 and receives an annual increament of Rs.600 2. if Rs.1000 deposited in a bank which pays annual interest compounded annualy. Ex: A man invest R.10000 for two years at the rate of 10% per annum in a bank. Find the diffrence between AP and GP(Simple interest - AP , Compound iterest - GP	**AS 1:** Drill and practice	Concept attainment	Patterns which occur in day to day life	i) Teacher give examples related in day to day life ii) Teacher discuss the pattern (Number's) in which succeeding terms are in AP or GP	i) Students recollects the patterns in day to day life ii) Students create the patterns in the number system on their own
		AS 2: Classification of attributes	Concept forming	Developing critical thinking	Teacher classifies AP and GP by using various illustrations related to Students Environment	Students organizes and classifies terms of AP and GP
		AS 3 Analytical and Synthetic Method	Analogy	Identification of familiarities between two concepts	i)Teacher introduce the concept AP and GP ii) Teacher analyses and syntheses difference between AP and GP for the given problem	Students form new sequence by relating with familiar concepts like simple interest

3	**Algebra /** Solution of a quadratic equation by completing square Ex : $x^2 + 2x + 1 = 0$ $[x^2 + 4x + 1 + 3] - 3 = 0$ $(x+2)^2 - (\sqrt{3})^2 = 0$ $(x+2+\sqrt{3})(x+2-\sqrt{3}) = 0$ $a^2x^2 - 3abx + 2b^2 = 0$ $x^2 - \frac{3b}{a}x + \frac{2b^2}{a^2} = 0$ $x^2 - 2(\frac{3b}{2a})x + \frac{9b^2}{4a^2} = \frac{9b^2}{4a^2} - \frac{2b^2}{a^2}$ $(x - \frac{3b}{2a})^2 = \frac{9b^2 - 8b^2}{4a^2}$ $x - \frac{3b}{2a} = \pm\frac{b}{2a}$	AS1: Co-operative learning method	Reciprocal teaching	Group discussion	i)Teacher summarizes the concept ii) Teacher clarifies to solve quadratic equation bycompleting square	i) Student actors as a facilitator in a small group ii) Student discusses the ways in solving a quadratic equation
		AS2: Demonstration method	scaffolding	Specification and sequencing of activities	i) Teacher provides cues, hints to solve. ii)Teacher provides structures to transfer the constant, to eliminate the coefficients of x2, to split coefficient of x by second term and using the	i) Students link the step one by one for solving i) Students follow the cues given b the teacher.
4	**Matrices /** Solving equation	AS:1 Inquiry method	Brainstorming	Debate	Debate i)Teacher makes the students to identify rows and columns ii) Explains the various method of solving equations	I) Students write matrices with different number of rows and columns ii) Students solve equations using various methods

	Item 1	Item 2	Item 3	Item 4
Fat	5	0	1	10
Carbohydrate	0	15	6	9
Protein	7	1	2	8

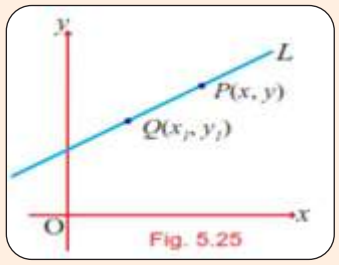
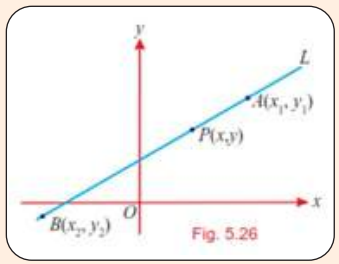
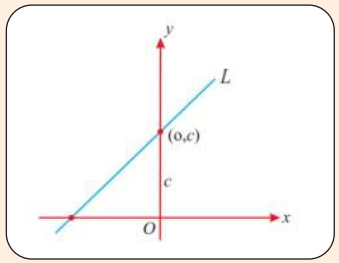
Identification of rows and columns

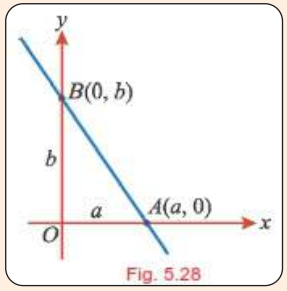
A fruit vendor sells fruits from his shop. Selling prices of Apple, Mango and Orange are Rs.20,Rs10 and Rs.5 each respectively. The sales in three days are given below

Day	Apples	Mangoes	Oranges
1	50	60	30
2	40	70	20
3	60	40	10

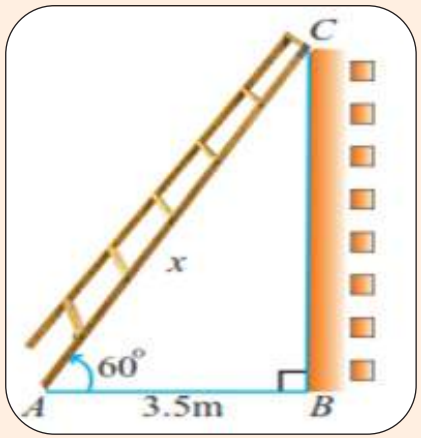
Write the matrix indicating the total amount collected on each day and hence find the total amount collected from selling of all three fruits combined.

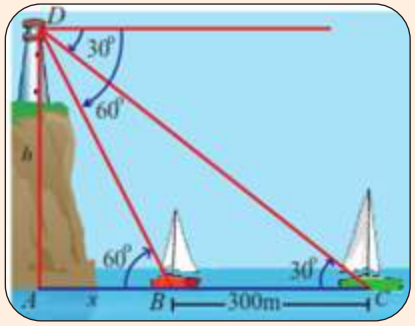
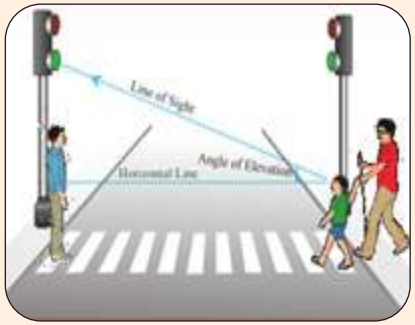
				solve equations using various methods
AS2: Direct instruction method	Concept attainment	Giving illustration	I) Cites examples from real life situations ii) simplifies the equation by multiplying rows and columns	I) Students discover the basic ideas of rows and columns ii) Students solve the equations in groups iii)students provide solutions to the product of matrices

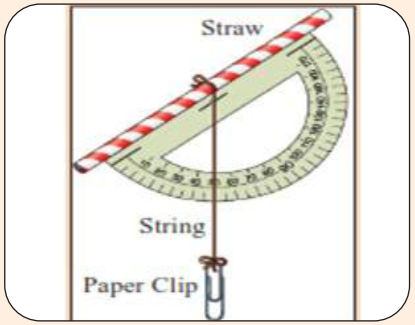
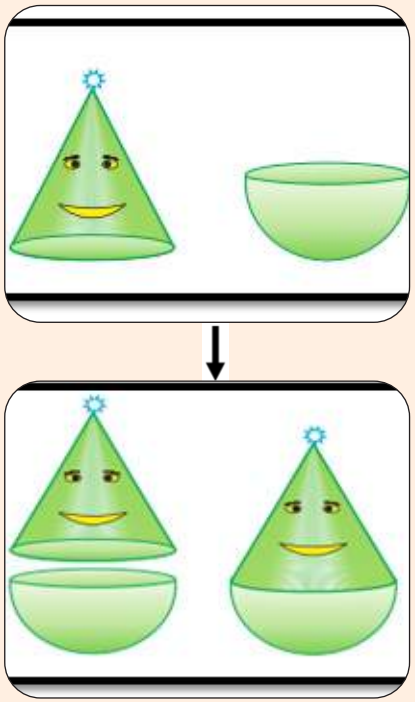
5	**Co-ordinate geometry/** Equation of a straight line  Fig. 5.25  Fig. 5.26  $\frac{x}{a}+\frac{y}{b}=1$	AS:1 Direct Instruction method	Inquiry method	Drill and practice	I) Encourage the pupils to identify the co ordinate. ii) Encourage the pupils to use various formula one by one ex : ex : $y = mx + c$ $y - y_1 = m(x - x_1)$	i) Student identifies the problem and the formulas to be used ii) Students applies the formulae and finds the solution

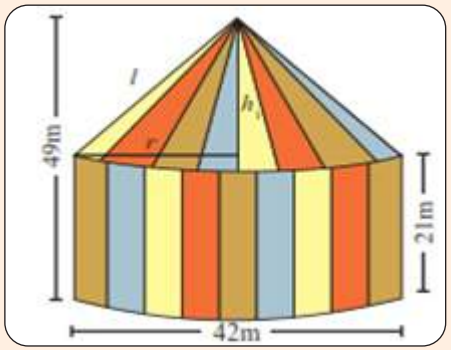
	 Fig. 5.28
	a) **Slope - point form**
	If the slope m and pair of point (x_1, y_1), then
	$y - y_1 = m(x - x_1)$
	b) **Two - points form :**
	If two pair of points (x_1, y_1) and (x_2, y_2) are given then $\frac{x-x_1}{x_2-x_1} = \frac{y-y_1}{y_2-y_1}$
	c) **Slope - intercept form**
	If the slope m and y Intercept c is given then
	$y = mx + c$
	d) **Intercepts form :**
	If x Intercept a and y Intercept b is given then
	$\frac{x}{a} + \frac{y}{b} = 1$
		As2: Analytic and synthetic method	Concept attainment	Concept cantered activity		

					i) Teacher explain the concept ii) Teacher explain idea when to use right formula iii) Teacher explain difference between the formula	i) Student learns the concept by discussion ii) Student learn the formula where to apply iii) Student discuss is the group about difference using formula

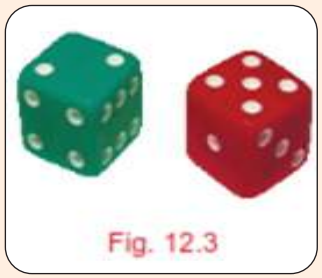
6	**Trigonometry** Heights and distance Ex: 1 A ladder leaning against a vertical wall , makes an angle of ground. The foot of the ladder 3.5m away from the wall.  Angle of elevation of Ex : 2 A girl standing on a light house on a cliff near the seashore observes to boats due east of the light house.	AS1 Visualization	Direct instruction	Explanation	i) Teacher explains the concept of Elevation and line of vision ii) Teacher explain the concept of depression	i) Students learns angle of elevation by looking trees, building , etc ii) Students learn angle of depression by looking from the top of the building

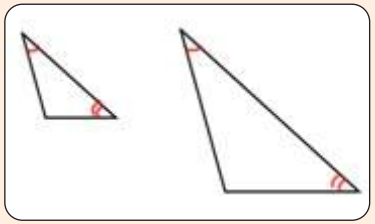
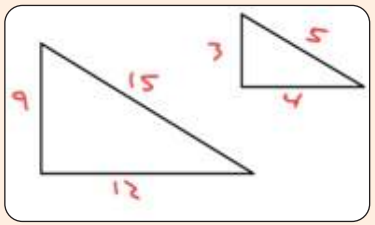
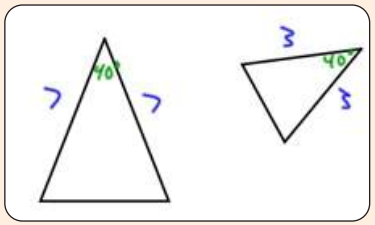
	 The angle depression of the two Boats are 30° *and* 60°  If an object is above the horizontal line from our eyes, we have to raise our head to view the object in this eyes move through an angle formed by the line of sight and horizontal line is angle of elevation.	AS2 Demonstration method	Modelling	Observation	I) Teacher explain uses of trigonometry in preparing maps ii) Teacher explains position of an island is relative to the longitudes and latitudes	I) Students learns how trigonometry used in maps in real life ii) Students locate the islands in relation to the longitudes and latitudes

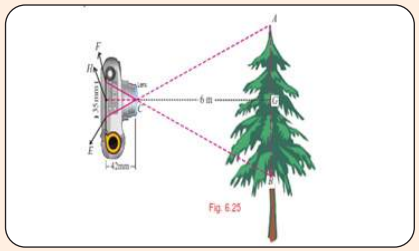
	 Using clinometer angle of elevation and depression were explained.	AS3 Learning by doing	Cooperative learning	Hands on learning	Teacher demonstrates angle of depression by using Clinometers	Students learn about the angle depression in group by using Clinometers
7	**Mensuration /** Combine figures and invariant volumes 	AS1 Demonstration method	Analogy	Teacher centered Activity	i) Teacher analyses the combined figures ii) Teacher explain similarities	I) Student identifies the similarities between two objects individually

	Teacher explains about the combination of Cone and Semi circle. Like this various combined objects were explained					
	 Teacher breakdown the combined shape a circus tent as a Cone surmounted on Cylinder . TSA = CSA of a Cylinder + CSA of a Conical part.	AS2 Analytic and synthetic method	Problem solving	Effective instruction by the teacher	i) Teacher breakdown the combined shape into smaller shape ii) Teacher explains the formula to be applied for the given shape iii) Teacher explain about the solution for given shape	i) Students discover the shape involved in the combined shapes ii) Students collect information from various sources regarding a given problem
	I) Teacher asks to visualize the following objects 1. Capsule 2. Water tank 3. Sharpen pencil etc. . . II) Teacher asks the student to identify combined objects III) Teacher ask to write formulae.	AS3 Demonstration method	Visualizations	Creating mental images	I) Teacher asks the student to visualize the combined objects they could see in day to day life (top capsules , etc)	i) Students draw the shapes as they visualized ii) Student identify the shapes involved in the drawn diagram iii) Students identifies the formula to solve the combined shape

8	**Statistics /** **Measure of Dispersion** Consider the following two different serious 1) 82 , 74 , 89 , 95 2) 120 , 62 , 28 , 130 Here mean is 85 in both the cases. But the numbers are widely scattered. Now how the data's are dispersed around the mean. Take ten of your friends quarterly mark in mathematics and find 1) Range 2) Co efficient of variation.	AS1 Direct instruction	Hypothesis testing	Teacher generates the Hypothesis and test the hypothesis	i) Teacher generates the hypothesis ii) Teacher investigates the generated hypothesis iii) Teacher explains how to find range, deviation for the data's	i) Students extend their understanding from measures of central tendency to measure of dispersion ii) Students starts investigating from general rule iii) Students draws a conclusion from a set of given data.
		AS2 Analytic and synthetic	Project based learning	Student centered approach	i) Teacher act as a facilitator. ii) Teacher guides in identifying types of dispersion. iii) Teacher guide the students to gather resources and information.	i) Teacher act as a facilitator. ii) Teacher guides in identifying types of dispersion. iii) Teacher guide the how to anipulate information.

9	**Probability /** Addition Theorem on Probability  Fig. 12.3 Two dies are thrown. Find the probability of getting a 5 either in first or second throw. $n(S) = 36$ $P(A) = \frac{n(A)}{n(S)} = \frac{6}{36}$ $P(B) = \frac{n(B)}{n(S)} = \frac{6}{36}$ $P(A \cap B) = \frac{n(A \cap B)}{n(S)} = \frac{1}{36}$	As1: Analytic and synthetic	Concept formation	Classification and organisation	I) Teacher classifies the events which are mutually exclusive and not so. ii) Teacher organizes the probabilities of the event. iii) Teacher generalizes the data and uses. $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ $P(\bar{A} \cap B) = P(B) - P(A \cap B)$ $P(A \cap \bar{B}) = P(A) - P(A \cap B)$	I)Students learn to classify the events which are mutually exclusive and not. ii) Students find $P(A \cup B), P(A), P(B), P(A \cap B)$ iii)Students applies addition theorem

10	**Geometry/** **Solving word problem using Theorem AAA**  **SSS**  **SAS** 	AS2 Demonstration method	Concept Attainment	Concept centered activity	Teacher demonstrates addition theorem on probability by using Venn Diagrams	Visualize the concepts and understands it.
		As1 Direct Instruction Method	Concept Attainment	Teacher centered activity to determine the critical attributes	i) Teacher differentiates similarity in Triangles. ii)Teacher explains the criteria to prove similar triangle (AAA, SAS, SSS, RHS,..)	i) Students compares similarity properties of triangles. ii) Students understand the criterion of two similar triangles in the group activity.

	 	As2 Problem Solving	Visualization	Simple activity helps to visualize similar objects	i) To clear that congruent figures are similar but converse need not be true. ii) Makes to realize and visualize what happened when the images are become smaller and smaller and larger and larger and larger. iii) Activities related to criterions in AAA,SSS,SAS and RHS.	i) Students differentiates congruent and the similar triangles. ii) Students learn the criterion for AAA,SSS,SAS and RHS similarities in Group activity. iii) Students present criterion for AAA,SSS,SAS and RHS in the class rooms.