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TOOLS AND TECHNIQUES OF ASSESSMENT FOR LEARNING: MATHEMATICS

INTRODUCTION:

Teaching for successful learning cannot occur without high quality assessment. Assessment, therefore, needs to be integrated with the process of teaching and learning. The greater the integration the better the outcomes of learning. Hence, assessment has to be so designed that it can be used as a powerful means of influencing the quality of what teachers teach and what students learn. But, while doing so special care must be taken to ensure that it is humane and it enables the learner to grow into a responsible and productive citizen. Not only this, evaluation has also to provide constant feedback regarding the effectiveness of course — contents, classroom processes and the growth of individual learners besides the appropriateness of the evaluation procedures. It must, however, be flexible enough to the extent that it can be experimented with and adapted according to the specific situations and needs of the learner groups.

10.1 TEST, EXAMINATION, MEASUREMENT, ASSESSMENT AND EVALUATION

Evaluation is a systematic process of collecting, analyzing and interpreting evidences of students' progress and achievement both in cognitive and non-cognitive areas of learning for the purpose of taking a variety of decisions. Evaluation, thus, involves gathering and processing of information and decision-making.

Some of the assessment words and their meanings

Assessment Terms	
Assessment	Assessment is a way of observing and collecting information and making decisions based on the information.

Continuous assessment

Continuous assessment refers to making observations and collecting information periodically to find out what a student knows, understands and can do. Specific tasks are given to the learners based on what has been taught. Teachers observe the learners doing these tasks and make a judgment about how well they are doing. Continuous assessment is ongoing and helps the teacher to find out what the learners have learned. Some other terms that are similar to continuous assessment are: classroom based assessment, running records, and teacher grading.

Evaluation

Evaluation is an overall judgment of student learning based on continuous assessment (and sometimes exams). Evaluation usually comes at the end of a semester, term or year.

Testing

Testing is one way of assessing learners on a continuous basis. Tests usually come at the end of a topic or unit to find out what a student has learned. Testing can include a wide range of question types, but the most common are multiple choice, true and false, essays and matching.

Exams

Exams are usually carried out at the end of the year or cycle (for example, at the end of primary school). Apart from knowing what grade they got, students do not often get feedback on their performance on the exams. Exams are usually written in the same way that tests are written. Exams often have important consequences for students' future.

Assessment activities

Assessment activities are activities given to learners to find out what they know and can do. An assessment activity is one in which the teacher is checking to see if learners have met

the objectives of the syllabus, lesson or curriculum. Children often learn a lot from good assessment activities. Examples of assessment activities are writing a story or paragraph, making a model, solving problems and role playing.

Features of Evaluation

- ❖ Evaluation will be humane in nature. It will help students grow as social beings and thus save them from unnecessary pain, anxiety, harassment and humiliation
 - ❖ Evaluation will be the responsibility of the teacher who teaches the students and is responsible for developing the requisite healthy attributes in them.
 - ❖ Evaluation will be consistent with its purpose and will provide a reliable and valid measure of students' performance.
 - ❖ Evaluation will reflect the outcomes of each learning intervention and would provide all the students the same opportunity to display their individual potential. As such, evaluation will be varied and consistent and thus admit of the use of multiple techniques of measurement.
 - ❖ Evaluation will be built in with the teaching-learning process and thus will be carried out through the entire period of education.
 - ❖ Evaluation will take into account both the background and the prior experiences of students.
 - ❖ Alternative evaluation procedures will be used for students with special needs making it humane, learner friendly and flexible.
 - ❖ Procedures for grading and their reporting will be appropriate and easily understood by one and all.
 - ❖ Evaluation will restore the faith and trust of masses by ensuring transparency in the procedures.
 - ❖ Modern technology will be used not only to improve the management of evaluation system but also to administer tests using computer networks.
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Evaluation at Different Stages

- ❖ Assessment and evaluation at different stages can be inter-twined in classroom by following the below process:
 1. **When the teacher starts any lesson, he/she should know the following:**
 - ❖ Present status of knowledge of the students.
 - ❖ Capabilities, interest and needs of the students.
 2. **During teaching learning process the teacher needs to,**
 - ❖ Connect the present knowledge with the previous
 - ❖ Clear the misconceptions
 - ❖ Modify the requirements of the students conceptual knowledge to improve their performance
 - ❖ Select appropriate strategies and approaches of teaching-learning.
 - ❖ Monitor process of their learning of concepts and development of new knowledge through continuous questions and feedback.
 - ❖ Encourage them to reflect their learning.
 - ❖ Facilitate them to construct and reconstruct the new knowledge.
 - ❖ Evaluate their continuous learning by testing their understanding.
 3. **At the end of the lesson/unit/session,**
 - ❖ Do the judgment of learning of the students,
 - ❖ Document their learning evidences,
 - ❖ Make final assessment of learners.
 - The Present Proposition**
 - ❖ The present proposition of evaluation in schools reiterates the reforms that have yet to be implemented. However, it is different from the earlier ones in a number of ways as it:
 - ❖ Lays adequate emphasis on both the formative and summative evaluation covering scholastic as well as co-scholastic abilities;
 - ❖ Underlines the significance of the comparison of a student's performance with reference to her/his own-self, criterion set by the teacher and the performance of her/his peer group;
 - ❖ Details out stage wise evaluation procedures starting from the pre-primary to the higher secondary stage of schooling;
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- ❖ Lays stress on mastery learning approach by using diagnosis and remediation for weaker students and enrichment programme for the brighter ones;

- ❖ Recommends the use of different method of grading scholastic and co-scholastic areas and also for school-based and public examinations; Pleads for the application of different point grade systems for different stages of school education; encourages the use of portfolios for record keeping and reporting; urges the use of both self and peer appraisal as vital components of the continuous and comprehensive evaluation; favors the introduction of tutorials at the higher secondary stage; proposes the introduction of semester system at the secondary stage and semester system with credits at the higher secondary stage; values the use of alternative evaluation procedures for learners with special needs; argues for the conduct of periodic achievement surveys in different subject areas at every terminal stage of schooling; and favors the application of modern technology in evaluation.

10.2 CONTINUOUS AND COMPREHENSIVE EVALUATION (CCE)-EDUCATIONAL ASSESSMENT AND EDUCATIONAL EVALUATION, PERFORMANCE-BASED ASSESSMENT: A FLEXIBLE WAY OF SCHOOL BASED ASSESSMENT

10.2.1 WHAT IS CCE?

CCE refers to a system of school based assessment that covers all aspects of student's growth and development. The main aim is to find out how far the curricular goals were achieved.

It emphasizes **two** fold objectives

1. Continuity in evaluation and assessment of broad based learning
2. Behavioral outcomes - Academic/ Curricular Standards

CCE comprises three areas:

- a) continuous
 - b) comprehensive
 - c) evaluation
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- a. **Continuous** - Assessment is regular and periodical. Evaluation of student's growth and development is continuous process rather than an event, built into the total teaching learning process and spread over the entire span of academic session.

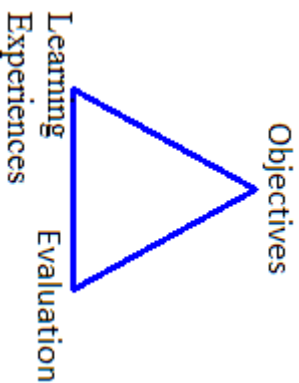
- b. **Comprehensive** - is a holistic approach, covers both scholastic and co- scholastic areas. It provides ample opportunity for the child to grow in all areas.

- c. **Evaluation** - is assessment of child in all aspects. The emphasis shifted to testing of holistic learning.

Guiding Principles

- ❖ Keeping the potential of the child to learn always in focus,
 - ❖ Respecting the systems of knowledge such as languages children bring to school,
 - ❖ Connecting knowledge to life outside the school; children should not feel that,
 - ❖ Ensuring that learning is shifted away from rote methods and the focus should be on interactions, project work, analysis etc. what they are learning at school should have relevance to their lives,
 - ❖ Enriching the curriculum to provide for overall development of children rather than remain textbook centric (Curricular & Co-curricular Activities),
 - ❖ Promoting social constructivism, issue-based curriculum and critical pedagogy across curricular areas,
 - ❖ Nurturing towards flora and fauna and respect for bio-diversity and social diversity, respect to the work shall be promoted as a part of school curriculum,
 - ❖ Locating classroom practices in the languages and cultures of children.
 - ❖ Making examinations more flexible and integrated into classroom life; more focus on assessment for learning than assessment of learning.
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Concept of continuous Evaluation



Examination reforms are an important component of curriculum and the evaluation is powerful means of improving the quality of Education. All the educational committees recommended for reducing emphasis on external examinations and encouraging internal assessment through CCE. The scope of evaluation in schools extends all the areas of learner's personality development. It includes both scholastic and co-scholastic areas and should be comprehensive in nature. This is in line with the goals of education. Continuous evaluation reveals the strengths and weaknesses of learners more frequently and it also provide feedback to the teachers for modifying their teaching strategies.

The Present Status of Assessment:

- ❖ Mismatch between curricular goals and assessment content.
- ❖ Domination of Paper Pencil test and no focus on oral and performance test.
- ❖ The test results do not impact on teaching because the next stage of syllabus will be tested on the next examination.
- ❖ Individual children learning needs downgraded in the push to cover the syllabus before next assessment.
- ❖ Memory oriented responses without much focus on original thinking and expression.
- ❖ Education seen as transmission of information and learning reproduced from the textbooks.
- ❖ The curriculum aims at developing a holistic personality but the practice reflects transaction of few subjects i.e. Languages and Non-

Languages and no focus on creative areas like; arts, crafts, values, health and physical education, life skills etc.,

- ❖ The assessment do not focus during learning but after learning (after completion of unit / term) and helps in categorizing the students as based performance.
- ❖ Teacher seldom takes assessment results as feedback to their teaching and change teaching learning processes and focus on neglected aspects of learning.
- ❖ More focus on teaching what is going to be assessed? Therefore use of guides and guide type material. .
- ❖ Educational change is limited by the power of the assessment practices.

Features of CCE and Examination Reforms

- Following are the proposed reforms as a part of implementation of CCE.
- ❖ Making examinations more flexible an integrated into classroom teaching through formative assessment.
 - ❖ Ensuring that learning is shifted away from rote methods and memory oriented and focus on self-expression.
 - ❖ Grading in place of marks (Marks based grading system).
 - ❖ Assessment of subject specific academic standards / competencies rather than information.
 - ❖ Assessment is school based through teacher made test papers.
 - ❖ Questions which are analytical and open ended which discriminate children of various abilities.
 - ❖ Teacher maintaining child wise, subject wise performance register.
 - ❖ The assessment tools are not only pen paper but also oral, projects, observations, portfolios, class work, activity reports etc. ,
 - ❖ Evaluation made comprehensive including co-curricular areas such as Art Education, Games And Sports, Work Experience, Value Education etc.,
 - ❖ Evaluation made continuous and now become part of teaching through formative assessment.

- ❖ Progress report compresses with descriptive statement on children performance covering all curricular areas.

- ❖ Periodic sharing of children progress with SMCs and parents.

10.2.2 EDUCATIONAL ASSESSMENT AND EDUCATIONAL EVALUATION

Assessment starts with a base line assessment at the beginning of academic year for all subjects and classes based on which the teacher set targets and plan for teaching.

Evaluation in schools needs to be profitably exploited for the development of both cognitive and non-cognitive capacities. This warrants adequate emphasis on both the formative and summative forms of evaluation. While formative evaluation is done during the course of instruction with a view to improving students' learning, summative evaluation is done at the end of the academic year to promote students to the next grade. Both these types of evaluation are essential and, therefore, need to be carried out to realize the goal of bringing about qualitative improvement in school education. The main purpose of formative evaluation is to monitor the instructional process in order to determine whether learning is taking place as planned. The result of such evaluation needs to be used for designing and providing remedial measures for slow learners and enrichment programmes for the brighter ones. On the other hand, summative evaluation needs to be used for classification of placement and prediction of future success apart from promotion to the higher class.

- ❖ Analyses and interpretation of the evidences collected through both the formative and summative evaluation may be viewed in three different ways:
 - ❖ First, by assessing the students' progress with reference to their own selves (self-referenced),
 - ❖ Secondly, with reference to the criteria set by their teacher (criterion-referenced), and
 - ❖ Thirdly, with reference to the progress made by their peer groups (norm-referenced).
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Evaluation must facilitate all-round development of students. It will, therefore, be desirable to have school-based system of students' evaluation, both formative and summative, from Classes I-XII. However, at the pre-primary level evaluation will be entirely formative in nature and only at the end of Classes X and XII will the final examinations be conducted by the boards as far as the scholastic areas are concerned. The school-based evaluation, which will be in the form of continuous and comprehensive evaluation, will incorporate not only the scholastic areas but also the co-scholastic areas of students' growth. In Classes X and XII, however, the performance of students in co-scholastic areas will be assessed by the school and conveyed to the board for inclusion in the statement of marks or grades awarded in the scholastic areas of study.

10.2.3 PERFORMANCE-BASED ASSESSMENT: A FLEXIBLE WAY OF SCHOOL BASED ASSESSMENT

What is to be assessed?

The total feedback on child's learning includes:

- ❖ The child's learning and performance in different subject domains.
- ❖ The child's skills, interests, attitudes, motivation etc.
- ❖ The changes that are happening in the learning process and behavior of the child and the developments that have occurred in a stipulated period of time.
- ❖ The reaction of the child to the different contexts and opportunities in and out of the school.

Academic Standards:

Academic standards are clear statements about what students must know and be able to do. The following are categories on the basis of which we lay down academic standards.

I. Problem Solving

Using concepts and procedures to solve mathematical problems.

a. Kinds of Problems

Problems can take various forms – puzzles, word problems, pictorial problems, procedural problems, reading data, tables, graphs etc.

b. Problem solving

- ❖ Reads problems
- ❖ Identifies all pieces of information/data
- ❖ Separates relevant pieces of information
- ❖ Understanding what concepts is involved
- ❖ Recalling of (synthesis) concerned procedures, formulae etc.
- ❖ Selection of procedure
- ❖ Solving the problem
- ❖ Verification of answers of raiders, problem based theorems.

c. Complexity

The complexity of the problem is dependent upon

- ❖ Making connections
- ❖ Number of steps
- ❖ Context unraveling
- ❖ Nature of procedures

II. Reasoning Proof

- ❖ Reasoning between various steps (involved variably conjecture)
- ❖ Understanding and making mathematical generalizations and conjectures
- ❖ Understanding and justifies procedures. Examining logical arguments.
- ❖ Understanding the notion of proof.
- ❖ Uses inductive and deductive logic
- ❖ Testing mathematical conjectures

III. Communication

- ❖ Writing and reading, expressing mathematical notations (verbal and symbolic forms)
- ❖ Example : $3 + 4 = 7$, $3 < 5$ Sum of the angles = 180°
- ❖ Creating mathematical expression
- ❖ Explaining mathematical ideas in her own words like – a square is closed figure having four equal sides and equal angles.
- ❖ Explaining mathematical procedures like adding the digits at the tens place/ keeping in mind carry over.

- ❖ Explaining mathematical logic.

IV. Connections

- ❖ Connecting concepts within a mathematical domain – for example relating adding to multiplication, parts of a whole to a ratio, to division. Pattern and symmetry, measurements and space.
- ❖ Making connections with daily life.
- ❖ Connecting mathematics to different subjects
- ❖ Connecting concepts of different mathematical domains like data handling and arithmetic or arithmetic and space
- ❖ Connecting concepts to multiple procedures.

V. Visualization & Representation

- ❖ Interprets and reads data in a table, number line, pictograph, bar graph, 2-D figures, 3-D figures, pictures
- ❖ Making tables, number line, pictograph, bar graph, pictures.
- ❖ Mathematical symbols and figures

Types of Assessment

(A) Formative Assessment

(B) Summative Assessment

(A) Formative Assessment

Formative Assessment is an assessment conducted during the process of teaching. It is through observation of student responses, student engagement, student notebooks, assignments and other written works. Formative Assessments will be conducted by the teacher during instructions. The teacher observes and record the children progress and as well as learning gaps. FA is Assessment for Learning and Assessment of Learning.

Some of the main features of formative assessment

- ❖ Is diagnostic and remedial and in the form oral, written and performance.
- ❖ Makes the provision for effective feedback.
- ❖ Enables teaches to adjust teaching to take account of the results of assessment.

- ❖ Recognizes the need for students to be able to assess themselves and understand how to improve.
- ❖ Builds on student's prior knowledge and experience in designing what is taught.
- ❖ Encourages students to understand the criteria that will be used to judge their work.
- ❖ Offers an opportunity to students to improve their work after feedback.
- ❖ Helps students to support their peers.
- ❖ Formative Assessment is Assessment for Learning and assessment as learning.

(B) Summative Assessment

Summative assessment takes place after a period of instruction and requires making a judgment about the learning that has occurred. This is through using paper pencil tests. It is to takes place at end of term semester or school year. Special learning outcomes and standards are reference points, and grade levels may be the bench marks for reporting. This is assessment of learning.

The techniques and tools for formative evaluation:

The children's learning process is continuously checked and monitored and formative evaluation. Different kinds of tools and techniques must be used to observed and record the different types of behavior. **These are as follows:**

1. *Daily observations and Oral work - 10 Marks.*
2. *Projects and experiments - 10 Marks.*
3. *Slip Test (unannounced informal test) - 20 Marks.*
4. *Children written works - 10 Marks.*

Children written works means

- ❖ *Notebooks (Class work and Home work),*
- ❖ *Assignments,*
- ❖ *Portfolios,*
- ❖ *Children diary etc.*

Formative Assessment – Operational Strategy

- ❖ **Techniques of Assessment** – Classroom observations, Oral examinations, Written examinations, Participation in group work, Practicals etc.
- ❖ **Tools of Assessments** – Children self-writing of exercises given at the end of the each lesson and other written works, Projects, Anecdotal records, Rating scales, Checklists etc.
- ❖ **Periodicity** – Continuous observation, however recording may be once in about two months period.

Tools and techniques for Summative Evaluation

Summative Evaluation should based on the written and oral tests.

Following are the tools for summative evaluation

- ❖ **Oral work** (*questions and answers, reading aloud, reading comprehension, speech and conversation, role playing, interview, group discussions, etc.*).
- ❖ **Written Test** – *Pen Paper test*

The questions must be qualitative i.e., open ended, analytical in nature, drawing conclusions, giving reasons, evaluating and interpreting in nature. They must discriminate children based on their intelligence and creativity.

Assessment of Co-curricular areas –Operational strategy

- ❖ **Techniques of Assessment** –

Observation in the classroom and outside and during the course of participation in various activities.

- ❖ **Tools of Assessment** – *Anecdotal records, Rating scales, Checklists etc.*

- ❖ **Periodicity of Assessment** – *Once every term based on classroom and outside behavior (quarterly assessment)*

When to Assess? – Periodicity

- ❖ **Base line test – June (Baseline)** – A baseline test which is diagnostic in nature to be conducted at the beginning of the academic year to understand how far the children posses expected competencies to follow the regular syllabus of the class. In case if

the children do not possess required basic competencies a remedial teaching shall be planned by the concerned teachers.

- ❖ **Formative Assessments:** This is a part of teaching learning process the teacher observes performance of the children through questioning, observation of children notebooks, assignments, class works, projects, children participation in the learning process, group works etc., The teacher has to record in the following months for Formative Evaluation against the given tools i.e. Observations, Written works, Project works, Slip tests.

- 1 **Formative Assessment 1 – July**
- 2 **Formative Assessment 2 – September**
- 3 **Formative Assessment 3 – December**
- 4 **Formative Assessment 4 – February**

Summative Assessment: Summative Assessment is a terminal tests in nature and shall be conducted thrice in a year viz.,

- 1 **Summative Assessment 1 – September**
- 2 **Summative Assessment 2 – December**
- 3 **Summative Assessment 3 – April**

The subject wise question papers should be developed by the teachers based on the Academic Standards and it's weightages.

Who will Assess?

- ❖ School based assessment by the concerned teachers.
- ❖ Test papers must be teacher made and never from external sources.
- ❖ Memorized answers from textbooks, guide books are strictly prohibited and teachers must discourage by giving zero score for such answers. Encourage the children for their own and original expression, whatever may be the mistakes children commits (committing mistakes is ok).

Recording Children Performance

Marks based grading system will be followed Five point scale grade – A+, A, B+, B and C.

Marks Range	Grade
91 – 100	A+ Grade
71-90	A Grade
51-70	B+ Grade
41-50	B Grade
40 and Below	C

Records and Registers

- ❖ Every teacher must maintain a register viz., CCE showing the progress of children against subject specific learning indicators over base line.
- ❖ Recording Formative and Summative Evaluation details in the child's progress card.
- ❖ Every child completing his elementary education shall be awarded a certificate.
- ❖ A cumulative achievement record at two levels will be used i.e., a) for primary (I-V classes) and b) Upper Primary (VI-VIII).

Teachers Role:

- ❖ Developing competency based test items/ question papers with open ended, thought provoking, application oriented questions and take up school based assessment.
- ❖ Diagnostic and Remedial.
- ❖ Portfolio Management.
- ❖ Identify areas where student needs additional practice.
- ❖ Observations, Anecdotal records.
- ❖ Facilitate for peer and self-assessment.
- ❖ Demonstrating the performance of the children in the SMC/ Parent's Meeting.
- ❖ Maintenance of CCE Register and the Elementary education.

CCE and New Textbooks

- ❖ The new textbooks are based on academic standards and supports CCE.
- ❖ The textbook supports for undertaking Formative Assessment i.e. projects, experiments, field investigations, research/ information and other academic tasks.

- ❖ Syllabus and appropriate material for under taking co-curricular areas and their assessment.

CCE Implementation – Roles and Responsibilities:

The Head Master will be the 1st level officer to monitor the effective implementation of CCE and maintain all evidences for children progress with respect to FA and SA.

Other monitoring officials such as MEO, Dy.EO, DEO and DIET staff with clear cut roles and responsibility to support and monitor the program at District Level.

10.3 ASSESSMENT FRAMEWORK

As a teacher we need to make several decisions during teaching learning process about the

- ❖ Learner's abilities, aptitude, attitude, existing ideas, etc.
- ❖ Learning objectives, approaches and strategies to be adopted
- ❖ Teaching-learning materials
- ❖ Learning process
- ❖ Collecting evidences
- ❖ Tools techniques of assessment
- ❖ Recording and reporting of the assessment, etc.

Teacher can always assess her teaching through the following self-reflective questions:

- ❖ Are the students progressing?
- ❖ Are they facing any difficulties in learning?
- ❖ Does particular learner face any difficulty in learning?
- ❖ Are the methods of teaching-learning facilitating learner requirements?
- ❖ What modifications to be done in the teaching-learning approaches and strategies to give maximum benefit to learner?

In order to take the decisions the teacher needs to do continuous evaluation and assessment. Evaluation in schools needs to be profitably exploited for the development of both cognitive and non-cognitive capacities. This warrants adequate emphasis on both the formative and summative forms of evaluation. While formative evaluation is done during

the course of instruction with a view to improving student's learning, summative evaluation is done at the end of the academic year to promote students to the next grade. Both these types of evaluation are essential and, therefore, need to be carried out to realize the goal of bringing about qualitative improvement in school education.

A. Purpose of Assessment

The purpose of the assessment is

- ❖ To collect, analyze, and interpret evidences
- ❖ To judge the extent of student's learning.
- ❖ To give students the feed-back about their performance
- ❖ To give feedback to the teacher about the learning gaps and conceptual changes taking place in the students.
- ❖ Plan teaching-learning situations in more suitable way.
- ❖ Support and improve every learner's learning and development.
- ❖ Provide evidences of learner's progress so as to communicate the same to parents and administrators.
- ❖ Reflect the teaching-learning practices.

B. Learning Indicators (LI):

Learning Indicators show class wise progression in various dimensions of learning.

- ❖ They facilitate in curriculum transactions/ strategies i.e. pedagogy.
- ❖ Learning indicators are based on the premise that learning is a process in which the children are actively involved.
- ❖ Teachers also adapt their teaching as per the children's needs.
- ❖ From curricular expectations to learning indicators, the long term goal is achieved through short term goals indicated as learning indicators.
- ❖ This takes care of different learning styles & multiple intelligences.
- ❖ Children do not learn the same thing in the same way and they are given multiple opportunities to learn.

Learning Indicators need to be co-related at three stages.

1. The teacher starts by identifying the curricular expectations (learning outcomes) that the children will achieve at the end of the course/stage.
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2. The teacher plans the teaching - learning process – (Pedagogical Process).

3. The learning indicators inform the teacher and the children about the processes involved to achieve the curricular expectations/learning outcomes.

These goals are meaningful to children also, and over a period of time both the teacher and the children will appreciate and understand how the specific activities/tasks relate to these goals. It enhances collaborative learning. Therefore the pedagogical tasks designed by the teacher need to be challenging, authentic, integrative and interdisciplinary. The teachers' role in the entire process is that of a facilitator, co-learner and co-investigator.

B.1. Types of Learning Indicators:

Curricular Expectations and Learning Indicators in Mathematics for Classes VI to VIII ,a child:

- ❖ Moves from number sense to number patterns;
- ❖ Sees relationships between numbers and looks for patterns in relationships;
- ❖ Gains proficiency in using newer language of Mathematics like variables, expressions, equations, identities,, etc;
- ❖ Uses arithmetic and algebra to solve real life problems and pose meaning problems;
- ❖ Discovers symmetries and acquire sense of aesthetics by looking around regular shapes like triangles, circles, quadrilaterals, etc;
- ❖ Comprehends the idea of space as reason enclosed within boundaries of a shape;
- ❖ Relates numbers with shapes in terms of perimeter, area and volume and uses them to solve every day life problems;
- ❖ Learns to provide reasoning and convincing arguments to justify her/his own conclusions particularly in Mathematics; and
- ❖ Collects, represents (graphically and in tables) and interprets data/information from her/his life experiences.

CLASS-VI

Conceptual Area	Pedagogical Processes	Learning Indicators
Numbers <ul style="list-style-type: none"> ❖ Consolidates the sense of numberless up to 5 digits in terms of its size of estimation. ❖ Gets familiar with large numbers up to 8 digits. ❖ Solves word problems on large number operations. ❖ Understands the importance of brackets and other symbols like $=, >$. ❖ Formulates divisibility rules of 2, 3, 4, 5, 10 and uses them as and when required. ❖ Appreciates the classification of numbers as even, odd, prime, co-prime, etc. ❖ Understands the significance of HCF and LCM and finds them. 	<ul style="list-style-type: none"> ❖ Through various situations, make children compare numbers up to 5-digits like cost of two houses, number of spectators present in two cricket matches, etc. ❖ Number patterns could be used to extend numbers up to 8-digits and then daily life situations involving 8-digit numbers could be discussed e.g. cost of property. ❖ Involve children in solving daily life problems involving more than one operation and then to appreciate the hierarchy to be decided to carry on different operations. ❖ Divisibility rules can be introduced using patterns, and then different division problems could be discussed to show their use. For example, let 	<ul style="list-style-type: none"> ❖ Creates situations around her in which she finds numbers. ❖ Through situations like money transactions, measuring of height budget, etc. Child uses larger numbers and thus appreciates their use. ❖ Child attempts to construct examples through which she demonstrates the use of divisibility rules. ❖ Classifies numbers in various categories including even, odd, prime, composite, co-prime, etc. ❖ Given a fraction child identifies a situation for the given fraction. ❖ Uses divisibility rules to find factors of a number. ❖ Demonstrates her/his ways of finding HCF and LCM of two numbers.

<ul style="list-style-type: none"> ❖ Applies prime factorization to find HCF and LCM of numbers. ❖ By observing patterns, identifies and formulates rules for whole numbers. ❖ Evolves the properties of whole numbers like commutative, associative, distributive, additive identity, multiplicative identity, etc. ❖ Appreciates the need for negative numbers. ❖ Through patterns, formulates rules for ordering of integers, their representation on number line, addition and subtraction of integers, etc. ❖ Represents fractions and decimals pictorially and on number line. ❖ Finds sum and difference of two fractions. 	<p>children form multiplication tables of different numbers like 2, 3, 4, etc and then from the multiplication facts, ask them to identify the pattern like multiple of 3 has sum its digits divisible by 3, multiple of 5 has either 5 or zero in its one's place, etc.</p> <ul style="list-style-type: none"> ❖ Involve children in classification of numbers on the basis of their properties like even, odd, multiples and factors. ❖ Encourage children to create number patterns through which HCF and LCM can be discussed. ❖ Different number operations could be performed by students which through discussions could help to know the different properties like closure, commutative, associative, etc. ❖ Situations could be created and discussed in which numbers are 	<ul style="list-style-type: none"> ❖ Devises her/his strategies to identify appropriate situations to use the concepts of HCF and LCM. ❖ Creates daily life situations where opposites are involved and represents such quantities by positive and negative numbers. ❖ Makes her own strategies of ordering, adding and subtracting integers. ❖ Reduces fractions involving larger numbers to simplest (lowest) forms in order to handle the fraction for operations, comparison and other purposes. ❖ Tries to identify and extend a pattern ❖ Attempts to formulate the pattern identified by her and tries to suggest a symbol for a general term of the pattern and then describes a general term of the pattern
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<p>Algebra</p> <ul style="list-style-type: none"> ❖ Understands variables through patterns ❖ Classifies quantities as variable and constant ❖ Understanding algebra as generalization of arithmetic Ratio and Proportion ❖ Understands how the comparison of two quantities through ratio is different from comparisons done earlier. ❖ Understands the meaning of proportion · Knows how ratio and proportion are related to unitary method. Solves problems related to daily life using unitary method. <p>Geometry</p> <ul style="list-style-type: none"> ❖ Differentiates between different geometrical figures on the basis of their observable properties. 	<p>required to be represented for opposite situations, like points/ objects in different directions from a reference point, give and take situations, profit and loss, etc. · Daily life situations and pictures could be presented to introduce fractions and decimals like representing part of a whole as number, a dot mark placed to separate rupees and paise, meter and centimeter, kilometer and meter, litre and milliliter, etc. · Encourage children to look at the pictures showing sum and difference of like fractions and to generalize. · Let children evolve that to add or subtract two unlike fractions it is required to convert them into equivalent fractions of same denominators (like fractions).</p>	<ul style="list-style-type: none"> ❖ Attempt to compare quantities using ratio · Demonstrates her understanding of the concept of proportion by constructing examples · While solving problems on unitary method child tries to understand unit of which quantity is to be found. · Finds rate and the total amount in related context using unitary method. · Classifies triangles in to different groups/types on the basis of their angles and sides. · Classifies quadrilaterals in to different groups/ types on the basis of their properties. · Draws different types of triangles and quadrilaterals using her understanding about the shapes. · Generalizes that a closed figure divides the surface in to three parts.
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<ul style="list-style-type: none"> ❖ Classifies figures as Open and closed ❖ Identifies interior and exterior of closed figures ❖ Describes line, line segment, ray, curvilinear and linear boundaries. ❖ Classifies angle into different types on the basis of their measurement and describes elements of angle like vertices, arms, interior and exterior. ❖ Understands the difference between different types of triangles and the basis on which they are classified. ❖ Describes vertices, sides, angles, interior and exterior, altitude and median of a triangle. ❖ Classifies quadrilaterals as trapezium, parallelogram, rectangle, square, rhombus. · 	<ul style="list-style-type: none"> ❖ Situations may be presented before the children that would prompt them to form patterns and feel the need for a symbol in place of number. ❖ Involve children in generalization of patterns by using letters for numbers called variable or unknown. ❖ Children should be asked to write/ describe various daily life situations in mathematical terms using letters and numbers. This will help them in generation of expressions and equations ❖ Discussions may be held to show different methods of comparison of quantities like by taking difference, division and then ratio ❖ Children may be encouraged to create examples to show the difference between ways of comparison of quantities done 	<ul style="list-style-type: none"> ❖ Attempts to construct solids using their nets. ❖ Observes the objects and makes strategies to decide about the symmetry of the object. ❖ Observes the reflection of objects in mirror and then attempts to formulate rules about the symmetry of the object. ❖ Attempts to reason out the logic behind drawing an angle of certain measure using geometrical properties. ❖ After learning to draw an angle of certain measure, child tries to device ways to draw related angles. ❖ Describes the elements of a 3-D shape like its types of surfaces, edges, corners, etc. ❖ Identifies perpendicular lines in her vicinity and draws such lines.
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<p>Understands circle and its components like center, radius, diameter, arc, sector, chord, segment, semicircle, circumference, interior and exterior.</p> <ul style="list-style-type: none"> ❖ Identifies 3-D shapes and their elements. ❖ Identifies 2-D symmetrical objects. ❖ Understands reflection symmetry. ❖ Constructs angles of different measures using compasses. ❖ Draws perpendicular line segments. <p>Mensuration</p> <ul style="list-style-type: none"> ❖ Understands the concept of perimeter and area of a shape. ❖ Deals with special case when a rectangle is a square. ❖ Derives general formulae to find perimeter and area of rectangles 	<p>through operation of subtraction and that through ratio</p> <ul style="list-style-type: none"> ❖ Examples could be discussed to show the difference between ratio and proportion and to relate them. ❖ Daily life problems related to unitary method could be discussed such as shopping finding the rate etc. ❖ Activities may be performed in which students can be shown concrete models and pictures of different geometrical shapes. Students can be involved in activities related to identify, angles, triangles and quadrilaterals and nets. ❖ A better way of connecting 2-D with 3-D shapes is relating nets of various solids with their shapes. ❖ Models and nets of 3-D shapes can be made by students to get an idea of their edges, faces, etc. 	<ul style="list-style-type: none"> · Child demonstrates her ways to calculate the perimeter of different shapes given. She/he tries to formulate the perimeter of shapes like rectangle, square, etc. · Child demonstrates her ways and strategies to calculate the areas of rectangle and square by dividing them into appropriate smaller units. She/he attempts to use such smaller units. · Child tries to identify daily life situations in which the information is required to be properly arranged in terms of tables. · Child tries to explore different ways to organize and represent data as pictures, graphs, etc.
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<p>Data Handling</p> <ul style="list-style-type: none"> ❖ Understands the use of organizing data. ❖ Uses tally marks to organize data. ❖ Represents data through pictograph, bar graph. 	<ul style="list-style-type: none"> ❖ Discussion can be held after showing objects to the children. ❖ Activities can be performed using mirror and children may be made to observe the reflections. The observations can then be discussed. Folding a paper cut out of a shape along specific lines can also be used to show the reflection symmetry in case the two halves exactly cover each other. ❖ After discussing the drawing of 60° angle using compasses, the construction of other angles like 30°, 120°, etc. can be discussed with the children. Give them a feel of dividing a circle into equal segments that correspond to angle. For example, a circle can be divided into six equal parts by the chords of length equal to radius of the circle and this actually forms $1/6$th of complete 	
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	<p>angle i.e. 60° at the center. Different geometrical figures may be given to draw that involves angles of various measures, line segments, etc.</p> <ul style="list-style-type: none"> ❖ Different shapes can be shown to the students and through the notion of boundary, the concept of perimeter can be discussed. ❖ Discussion can be held about boundary and region, which can lead to the concept of area. ❖ Daily life situations involving quantitative information can be discussed with the students. ❖ Discussion can be held about why data should be organized. Children can be motivated to use their own ways of organizing data. ❖ Children may be asked to explore their own ways of representing the data in picture and in table of numbers. 	
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CLASS-VII

Conceptual Area	Pedagogical Processes	Learning Indicators
Numbers <ul style="list-style-type: none"> ❖ Understands and performs multiplication and division of integers ❖ Evolves properties of integers (including identities for addition and multiplication, commutative, associative, distributive) ❖ Word problems including integers. · Solves problems using operations on integers · Multiplies and divides fractions ❖ Understands mixed fractions ❖ Defines rational numbers. ❖ Performs operations on rational numbers · Describes the decimal representation of rational numbers · Multiplies and divides decimal fractions. 	<ul style="list-style-type: none"> ❖ The rules for multiplication and division of whole numbers have already been studied by children. Involve children in discussion to find their ways of multiplying integers. Use of patterns in multiplying a negative integer by another integer may be a new idea for children as up till now they have learnt that multiplication is repeated addition or an operator in case of fractions. Give proper time to children to appreciate why product of two negative integers is positive. Similarly, encourage children to explore and using concept of dividing a natural number by another by simply finding the number which when multiplies the divisor gives the dividend as product. So, to find -4 , -2; we have to find the 	<ul style="list-style-type: none"> ❖ Demonstrates strategies to multiply two integers by using patterns and generalizes the rules to multiply a positive integer by a negative integer, a negative integer by a positive integer, and two negative integers. ❖ Evolves methods and algorithms to divide two integers by using patterns and forms rules to perform division in integers. ❖ Multiplies fractions by using patterns/ paper folding/pictures and generalizes the rules ❖ Finds rules to divide fractions by using patterns/visualization/picture and forms rules. · Develops her own definition of rational numbers as extension of fractions and integers. ❖ Attempts to form rules to add, subtract, multiply and divide rational

<ul style="list-style-type: none"> ❖ Converts units of length and mass from smaller to larger and vice-versa ❖ Solves problem using operations on rational numbers and decimal fractions ❖ Defines exponents and their laws <p>Algebra ALGEBRAIC EXPRESSIONS</p> <ul style="list-style-type: none"> ❖ Generates algebraic expressions ❖ Identifies constants, coefficient, powers, like and unlike terms and degree of an expression ❖ Adds and subtracts algebraic expressions ❖ Forms and solves simple linear equations in one variable (in contextual problems) with two operations. 	<p>number which on multiplication with -2 gives the result -4. Many children will be able to infer that the required number must be +2. Many such examples will help the children to make their own rule like +ve, -ve = -ve, -ve, +ve = -ve and -ve, -ve = +ve.</p> <ul style="list-style-type: none"> ❖ Involve children in classification of numbers on the basis of their properties like even, odd, multiples and factors. these numbers can be used to classify numbers in to various categories. ❖ Utilize children's knowledge about describing multiplication of fractions as operator 'of' and explain by paper folding, shading parts of whole, etc. for example S! $\times \frac{1}{2}$ is one-third of one-half. The double-shaded region is one-sixth of the whole which shows that S! $\times \frac{1}{2} = Y!$. Let 	<p>numbers by using the operations on fractions and integers.</p> <ul style="list-style-type: none"> ❖ Represents a rational number as decimal fraction and attempts to form rules for operations on decimal fractions. ❖ Provides reasoning to how divisibility rules work. ❖ Uses exponential form and rules to solve problems related to repeated multiplication. ❖ Observes patterns in multiplication tables and forms divisibility rules. ❖ Forms algebraic expressions involving one or two variables/ unknowns from daily life problems. ❖ Attempts to add and subtract algebraic expressions. ❖ Expresses real life situations in simple linear equations and solves them.
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<ul style="list-style-type: none"> ❖ Ratio and Proportion · Extends knowledge of Ratio and proportion and Unitary method continued ❖ Understands percentage as a fraction with denominator 100. ❖ Converts fractions and decimals into percentage and vice-versa. ❖ Understands profit and loss (single transaction only). ❖ Understands simple interest (time period in complete years). <p>Geometry Understanding shapes:</p> <ul style="list-style-type: none"> ❖ Describes pairs of angles (linear, supplementary, complementary, adjacent, vertically opposite). ❖ Evolves properties of parallel lines with transversal (alternate, corresponding, interior, exterior angles). 	<p>children do lot of such sums and observe the pattern that in all cases the product of fractions can be obtained by multiplying their numerators and their denominators. · means the number of one-fourths in one-half. Simple visualization is required to find that one-half contains two one-fourths. Let children observe pattern and find their own ways of dividing a fraction by another fraction.</p> <ul style="list-style-type: none"> ❖ Divisibility rules can be introduced using patterns, and then different division problems could be discussed to show their use. For example, let children form multiplication tables of different numbers like 2, 3, 4, etc and then from the multiplication facts, ask them to identify the pattern like multiple of 3 has sum its digits divisible by 3, multiple of 5 has 	<ul style="list-style-type: none"> ❖ Describes ratios as percentage and forms formulae for profit/loss and simple interest using unitary method. ❖ Applies knowledge of ratio and proportion to solve problems related to profit and loss · Derives formula to find simple interest using unitary method. ❖ Finds simple interest given time in complete years and rate of interest per annum. ❖ Identifies pairs of angles like linear, supplementary, complementary, adjacent and vertically opposite and finds the one when other is given. ❖ Hypothesize the relationship between pairs of angles out of eight angles formed by a transversal with parallel lines. ❖ Verifies angle sum and other properties of triangles and uses these
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<p>Properties of triangles:</p> <ul style="list-style-type: none"> ❖ Explores angle sum property and exterior angle property of a triangle. ❖ Concludes that sum of two sides of a triangle is greater than third side of a triangle. ❖ States and uses Pythagoras Theorem (Verification only). <p>Symmetry</p> <ul style="list-style-type: none"> ❖ Recalls reflection symmetry · Develops idea of rotational symmetry, observations of rotational symmetry of 2-D objects. <p>Representing 3-D in 2-D:</p> <ul style="list-style-type: none"> ❖ Identifies and counts vertices, edges, faces and nets (for cubes cuboids, and cylinders, cones). 	<p>either 5 or zero in its one's place, etc.</p> <ul style="list-style-type: none"> ❖ Involve children in exploring their ways of writing repeated multiplication in short form as repeated addition is represented by multiplication. With discussion let the children reach the conclusion of writing repeated multiplication in exponent form. ❖ Use child's context and encourage them to generate algebraic expressions by proper choice of variable/unknown and operations. ❖ Child's daily life experiences like adding/subtracting a group of 2 notebooks and 5 pencils to/from another group of 3 notebooks and 8 pencils, etc. Let children form their own rule that like terms can only be added or subtracted. 	<p>properties to find unknown elements of a triangle.</p> <ul style="list-style-type: none"> ❖ Appreciates the rotational symmetry of various shapes and figures. ❖ Reads simple maps and forms her own maps like home to school, map of her village, house, etc. ❖ Establishes congruence criterion for triangles and circles. ❖ Appreciates that only three elements of two triangles are sufficient to find their congruence ❖ Constructs simple triangles when three out of six elements are given(like three sides, two sides and included angle, a side and two angles, etc.) ❖ Measures approximate area of simple, regular and irregular closed shapes by using unit square grid sheet.
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<ul style="list-style-type: none"> ❖ Draws maps of the space around approximately through visual estimation. <p>Congruence</p> <ul style="list-style-type: none"> ❖ Examines congruence through superposition. ❖ Extends congruence to simple geometrical shapes e.g. triangles, circles. ❖ Evolves criteria of congruence (SSS, SAS, ASA, RHS). <p>Construction</p> <ul style="list-style-type: none"> ❖ Constructs a line parallel to a given line from a point outside it ❖ Constructs simple triangles by using ruler and a pair of compasses <p>Mensuration</p> <ul style="list-style-type: none"> ❖ Revises perimeter and idea of circumference of circle ❖ Has an idea of pie. 	<ul style="list-style-type: none"> ❖ Involve children in groups of three or four to explore situations which can be expressed by simple equations and solve them. Textbooks have many such examples. ❖ Children know about many ways of comparing quantity. Utilize their experiences to conclude that ratio is another way of comparing quantities. ❖ Percentages and their applications are also in child's daily life experiences which can be used to form various formulae and solving problems using them. ❖ Diagrams and use of upper primary mathematics kit (developed by NCERT) help children in visualizing the relationship between various pairs of angles when 'a transversal 	<ul style="list-style-type: none"> ❖ Forms formulae to find area of the region enclosed in a rectangle and a square as a better way of counting the number of units, squares that fill them completely. ❖ Finds various representative values for simple data from her/his daily life. ❖ Represents data by simple bar graphs and interprets them.
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<p>Area</p> <ul style="list-style-type: none"> ❖ Develops concept of measurement using a basic unit area of a square, rectangle, triangle, parallelogram and circle. <p>Data Handling</p> <ul style="list-style-type: none"> ❖ Collects and organizes data – choosing the data to collect for a hypothesis testing. ❖ Finds mean, median and mode of ungrouped data– understanding what they represent. ❖ Constructs bar graphs. ❖ Gets a feel of probability using data. 	<p>cuts two lines (parallel and non-parallel), angles of triangle and relationship among its sides.</p> <ul style="list-style-type: none"> ❖ Provide set of any three triangles on a sheet to each child. Ask him/her to measure the angles of the triangle and help them to reach the conclusion that sum of the angles of the triangles is 180° in each case. ❖ Encourage discussion in the class to generalize the above property of triangles. Similarly the activities to be conducted in the class room to explore the exterior angle property of triangles. ❖ The Upper primary mathematics kit developed by NCERT will provide enough data for learners to generalize the properties of triangles, quadrilaterals and transversals to parallel lines. 	
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	<ul style="list-style-type: none"> ❖ Involve children in experimentation with measurement of sides of right angled triangles and recognition of pattern to hypothesize the Pythagorean relation. ❖ Conduct activities with children given in textbooks (paper folding and observing diagrams) and encourage children to visualize symmetry and criterion for rotational symmetry of various shapes. ❖ Children working in groups with traced copies of various shapes and super-imposing one above the other help them in establishing congruence criterion. Provide practice with ruler and compasses to draw various geometrical shapes. More emphasis be given providing justification and logic on the accuracy of the constructed shape. 	
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- ❖ Involve children in activities targeted to measurement of region enclosed by closed figures on a plane surface and encouraging them to come to the conclusion that a unit is required. · Conduct activities related to measuring/counting the number of units squares within a figure drawn on a square grid and to compare various regions.
- ❖ Utilize child's daily life experiences and contextual problems to test hypothesis by collection and organization of data. Situations like finding a representative value to data help in understanding the idea of finding mean, median and mode of ungrouped data. Starting with small sets of numbers will be easier to visualize and represent it by bar graphs.
- ❖ Involve children in drawing inferences for future events from the existing data.

CLASS-VIII

Conceptual Area	Pedagogical Processes	Learning Indicators
Number System Rational Numbers: <ul style="list-style-type: none"> ❖ Describes properties of rational numbers. (including identities). Using general form of expression to describe properties. ❖ Applies operations on rational number. · Represents rational numbers on the number line. ❖ Understands that between any two rational numbers there lies another rational number. ❖ Solves word problems using rational numbers. Powers <ul style="list-style-type: none"> ❖ Describes laws of exponents with integral powers. ❖ Finds square and square roots using factor method and division method for numbers containing 	<ul style="list-style-type: none"> ❖ Involve children in writing general form of rational numbers and to associate it with rules of algebra. The operations on algebraic expressions will help in describing properties of rational numbers. · Let children use the rules for comparison of integers and fractions to develop their own rules for comparison of rational numbers. · Encourage children to conclude that half of the sum of two rational numbers lies between them and thus a rational number can be obtained between any two rational numbers. · Provide hints to the children to reach the conclusion that the process of finding a rational number between any two numbers never stops and thus there 	<ul style="list-style-type: none"> ❖ Describes properties of rational numbers and expresses them in general form. ❖ Performs operations on rational numbers. ❖ Reaches to the conclusion that between any two rational numbers there lies infinite rational numbers. ❖ Finds square, square root, cube and cube root of numbers using different methods. ❖ Provide logic and valid reasoning for divisibility tests of 2, 3, 5, 9 and 10. ❖ Multiplies two algebraic expressions and forms algebraic identities for square of binomials. ❖ Factorizes an algebraic expression using identities. ❖ Describes simple contextual situations into linear equations and

<p>(a) no more than total 4 digits and (b) no more than 2 decimal places.</p> <ul style="list-style-type: none"> ❖ Finds cubes and cube roots (only factor method for numbers containing at most 3 digits). ❖ Estimates square root and cube root. <p>Playing with numbers</p> <ul style="list-style-type: none"> ❖ Writes and understands a two and three digit number in generalized form ($100a + 10b + c$, where a, b, c can be only digit 0-9) and engages with various puzzles. · Solves and creates problems and puzzles. · Deduces the divisibility test rules of 2, 3, 5, 9, 10 for a two or three-digit number expressed in the general form. 	<p>lie many rational numbers between any two rational numbers. · Making children see that if we take two rational numbers then unlike for whole numbers, you can keep finding more and more numbers that lie between them. · Make children observe patterns in square numbers and to form their rules for perfect square numbers and square roots. · Likewise let children observe patterns in perfect cube numbers and form rule for cube root numbers · Allow children to play with numbers to find square roots and cube roots using prime factorization. · Let children practice the division method to find square roots of numbers. · Utilizing child's understanding about algebra introduce the generalized</p>	<p>solves them using different methods. · Applies the idea of percentage, profit loss and simple and compound interest in her/his daily life. · Derives rules to solve problems related to direct and inverse variations. · Solves problems related to time and work. · Generalizes sum of angles of a quadrilateral and uses it in solving various problems related to finding angles of a quadrilateral. · Explains properties of parallelograms and tries to reason out how one property is related to the other. · Represents 3-D shapes on a plane surface like paper, board, wall, etc. · Makes nets of prisms and pyramids, and forms shapes from the nets. · Identifies relationship among number of edges, vertices and surfaces in various 3-D shapes and generalizes it. ·</p>
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<p>Algebra Algebraic Expressions</p> <ul style="list-style-type: none"> ❖ Multiplies and divides algebraic expressions (Coefficient should be integers). ❖ Explores and verifies identities $(a \pm b)^2 = a^2 \pm 2ab + b^2$, $a^2 - b^2 = (a - b)(a + b)$ ❖ Factorizes expressions (simple cases only) as example the following types $a(x \pm y)^2$, $a^2 - b^2$, $(x + a)(x + b)$ · Solves linear equations in one variable in contextual problems involving multiplication and division (word problems) (avoid complex coefficient in the equations). <p>Ratio and Proportion</p> <ul style="list-style-type: none"> ❖ Solves slightly advanced problems involving applications on percentages, profit and loss, 	<p>form of 2 and 3 digit numbers and prove divisibility test of numbers. · The multiplication of algebraic expressions based upon the distributive property of multiplication over addition and subtraction of numbers. Moreover children already have the idea that same number multiplied repeatedly can be expressed in powers and the same is true for variables. Let children develop their own results for algebraic identities by using the multiplication of algebraic expressions. This can be further strengthened by using the algebra tiles as mentioned in the textbooks. · Continuing the idea of numerical coefficient and factors of a term to evolve methods of writing an expression in terms of product of two</p>	<p>Constructs quadrilaterals using compasses and straight edge given · Four sides and one diagonal · Three sides and two diagonals · Three sides and two included angles · Two adjacent sides and three angles · Finds area of trapezium and polygons by using square grid and also by using formulae. · Forms formula to find volume of a cuboid by observing and generalizing patterns of counting units cubes that completely fill the cuboids. · Finds surface areas of cuboids and cubes through their nets and later on by using appropriate formulae. · Makes hypothesis on chances of coming events on the basis of its earlier occurrences like after repeated throws of dice and coins.</p>
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<p>overhead expenses, discount, and taxes.</p> <ul style="list-style-type: none"> ❖ Differentiates between simple and compound interest (compounded yearly up to 3 years or half-yearly up to 3 steps only. ❖ Understands direct and inverse variations. · Solves simple and direct word problems ❖ Solves Time and work problems– Simple and direct. <p>Geometry Develops Understanding of Shapes including:</p> <ul style="list-style-type: none"> ❖ Properties of quadrilaterals – Angle sum property · Properties of parallelogram (By verification) (i) Opposite sides of a parallelogram are equal, (ii) Opposite angles of a parallelogram are equal, 	<p>or more expressions. This will lead to the factorization of algebraic expressions. · Give special emphasis to common errors that children commit while learning algebra like $2 + x = 2x$, $7x + y = 7xy$, etc.</p> <p>· The study of ratio and proportion continues from the class VI and VII. Simple problems related to percentages, profit and loss and simple interest will help learners in recapitulation of the basic ideas of these concepts and algorithms/ formulas. Children help children to arrive at the formula for compound interest through patterns and using it for simple problems. · There are many situations and variations in values of two variables which lead to classify them as direct and indirect or inverse variations. Involve</p>	
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<ul style="list-style-type: none"> (iii) Diagonals of a parallelogram bisect each other. (iv) Diagonals of a rectangle are equal and bisect each other. (v) Diagonals of a rhombus bisect each other at right angles. (vi) Diagonals of a square are equal and bisect each other at right angles. <p>Representing 3-D in 2-D</p> <ul style="list-style-type: none"> ❖ Identifies and matches pictures with objects [more complicated e.g. nested, joint 2-D and 3-D shapes (not more than 2)]. ❖ Draws 2-D representation of 3-D objects (Continued and extended) ❖ Counts vertices, edges and faces and verifies Euler's relation for 3-D figures with flat faces (cubes, cuboids, 	<p>learners in deriving the rules to solve problems related to these variations using ratio and proportions.</p> <p>· Involve children in activities of measuring angles and sides of shapes like quadrilaterals and parallelograms and to identify patterns in the relationship among them. Let them make their hypothesis on the basis of the generalization of the patterns and later on to verify their assertions. Use of Upper primary mathematics Kit will help learners in verifying their assertions/hypotheses. · Involve children in expressing/representing a 3-D shape into 2-D from their life like drawing a box on plane surface, showing bottles on paper, etc. · Let children make nets of various shapes like cuboids, cubes, pyramids, prisms,</p>	
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<p>tetrahedrons, prisms and pyramids).</p> <p>Constructs Quadrilaterals given:</p> <ul style="list-style-type: none"> ❖ Four sides and one diagonal. ❖ Three sides and two diagonals. ❖ Three sides and two included angles. ❖ Two adjacent sides and three angles. <p>Mensuration</p> <ul style="list-style-type: none"> ❖ Explores area of a trapezium and a polygon. ❖ Finds surface area of a cube, cuboid, cylinder. ❖ Understands concept of volume, measurement of volume using a basic unit, volume of a cube, cuboid and cylinder. 	<p>etc. Again from nets let them make the shapes and to establish relationship among vertices, edges and surfaces. Through pattern let them reach to Euler's relation.</p> <p>Children enjoy constructing various figures by using compasses and a straight edge. But it is also important to involve children to argue why a particular step is required. For example, on drawing an arc using compasses, we find all those points that are at the given distance from the point where the metal end of the compasses were placed.</p> <p>Children already know the method of finding area of a rectangle. Let children discuss in groups to convert trapezium and parallelograms into rectangles of equal area. This will help them in formation of formulae</p>	
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<ul style="list-style-type: none"> ❖ Volume and capacity (measurement of capacity). <p>Data handling</p> <ul style="list-style-type: none"> ❖ Arranges ungrouped data into groups, representation of grouped data through bar graphs, constructing and interpreting bar graphs. ❖ Draws simple pie charts with reasonable data numbers. ❖ Consolidates and generalizes the notion of chance in events like tossing coins, dice, etc. relating it to chance in life events. 	<p>to find these areas.</p> <p>In finding surface areas of cubes and cuboids involve children in opening such boxes and realize that all these surfaces are made up of rectangles and squares only. The rest of the job of finding total surface area will only be to add these areas.</p> <p>Children already have vocabulary related to measurement of volume and capacity through their daily life experiences. Involve them in activities to get a feel of filling a given space and to measure it by just counting the unit items that fill it completely. This will also help them in deciding why a cube is taken as a unit of measuring volume.</p> <p>Conduct activities related to throwing a large number of identical dice/ coins together and aggregating the</p>	
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B.2. ILLUSTRATIONS: LEARNING INDICATORS (LI)

i. Assessment of an activity

Theme : Data Handling Class : IV/V

Topic : Whose nose is the longest?

Material Required: Squared paper, Chart paper, gum/glue tubes/sticks, Scissors

Time Required: Two School Periods (in continuation)

Objectives/Expected Learning:

- (i) To learn how to collect & display data in the form of a bar graph.
- (ii) To interpret a bar graph and communicate the information to others.

Previous-knowledge: The students have some experiences related to data handling i.e. collecting data, tabulating data in an understandable form.

Creating Learning Situation

The teacher comes to the classroom and puts in the problem to the whole class. “Whose nose is the longest in the class?”

Some children smile at the strangeness of the question, some start looking around, some start using their fingers to try to measure the nose, some start whispering to others etc.

One student comments “Raju’s nose must be the longest.”

The class breaks into laughter.

The teacher repeats the question and says further “How would we find it out?” and also suggested that it will help if the students work in groups of 4 or 5.

The class starts rearranging itself into groups. Lots of discussion about “Who will be in which group?” “I want her/him to be here” takes place.

The class settles down in groups. The teacher asks for a confirmation and gets a positive response from all the groups.

The teacher repeats the problem & the challenges. A student: “To find this, we will have to measure the length of the nose of everyone” Teacher (in her thoughts): This child is good in communication.

Another Student: “Yes, we can do that in our groups.” The class seems to agree that the solution lies in the measurement of length of each one’s nose.

result of the throws to get large number of individual events. Involve children in making their assumption for the future events on the basis of the above data. Observing the aggregating numbers over a large number of repeated events also help in forecasting the chances of future events. · Comparing with the data for a coin. Observing strings of throws will help children in developing notion of randomness.