ECM101 Teaching & Learning of Primary Mathematics I
Number Sense and Place Value

1. What is number sense
   - Well-understood number meanings
   - Understanding multiple relationships among numbers
   - Recognition of the relative magnitude of numbers
   - Knowledge of the effect of operations on numbers
   - Referents to measure of thing in the real world
   
   In short, number sense is a good intuition about numbers and their relationships

2. Uses of numbers
   - Cardinal (quantity of a set)
   - Ordinal (the order of an object)
   - Nominal (name of object)

3. Levels of abstraction in number sense development
   - Concrete (actual objects)
   - Semiconcrete (pictures of objects)
   - Semiabstract (tally marks/number lines)
   - Abstract (numerals/letters)
4. Activities for helping children develop number sense
   - Sorting or classifying items into groups by different attributes
   - Recognition of the cardinal number of a group (rote counting vs rational counting)
   - One-to-one correspondence (as many as, more then, fewer than)
   - Ordering or sequencing (seriation)
   - Counting activities (counting by ones/tens, counting backwards, skip counting)
   - Recognising and writing numerals

5. Manipulatives for developing number concepts
   - Materials familiar to children – plastic spoons, forks, paper cups, paper plates
   - Commercial materials – Cuisenaire rods, base ten blocks, colour tiles, pattern tiles
   - Other physical counters e.g. picture cutouts

6. Understanding place-value concepts
   - Characteristics and benefits of a place-value numeration system
   - Place value, face, value and total value
   - Grouping and regrouping physical materials into tens and ones (renaming or regrouping)
   - Place-value box/chart/mat with proportional and non-proportional materials (base ten blocks, chip trading)
   - Notion of equivalent representations and different combinations
   - Standard notation, expanded notion and exponential notation
ECM101 Teaching & Learning of Primary Mathematics I
Addition and Subtraction of Whole Numbers

1. Developing addition & subtraction concepts
   - Emphasis on concepts and mathematical relationships
   - Proceed from concrete level through the semiconcrete, semiabstract, and abstract levels
   - Model number operations concretely using objects taken from children’s environment or commercial materials

2. Major concepts in comprehending addition and subtraction
   - Understand what addition/subtraction means (understand various situations)
   - Understand basic facts and memorise them
   - Relate place value concepts to addition/subtraction
   - Understand basic structures or properties of addition/subtraction
   - Understand regrouping concept and relate it to addition/subtraction

3. Meaning and models for addition
   - Addend + Addend = Sum
   - Commonly used models: groups of objects, number lines
   - Counting all, counting on
   - Counting is not addition
4. Developing basic addition facts
   - Organise basic facts into structures for memorization
   - Model number bonds/number families (make stories, use flash cards, play games)
   - Encourage thinking strategies and understanding of number relationships (additive identity, add one, doubles, counting by twos, commutative property of addition, make ten, associative property)
   - Writing the facts: horizontal format and vertical format

5. Extending basic addition facts using place value
   - Multiples of ten, adding tens
   - Adding two-digit numbers using expanded notation and place value
   - Model addition with renaming: recording the process and algorithm
   - Present an appropriate number of facts in each session and review facts already memorized regularly

6. Meaning and models for subtraction
   - Reverse/inverse operation of addition
   - Subtraction is finding a missing addend
   - Three subtraction situations: take-away, comparison, add-on,

7. Developing basic subtraction facts
   - Subtraction facts from addition facts: number bonds and number line
   - Subtraction facts from addition table
   - Memorise subtraction facts using structures
   - Extend basic subtraction facts using place value
   - Model subtraction with renaming using concrete counters and record results: use place value and expanded notation

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ECM101 Teaching & Learning of Primary Mathematics I
Multiplication and Division of Whole Numbers

1. Models to develop understanding of multiplication
   - Groups of objects
   - Arrays
   - Number lines
   - Repeated addition

2. Developing and memorizing basic multiplication facts
   - Develop the multiples of a number using models and skip counting
   - Discover basic structure (identity element, commutative, associative, distributive properties)
   - Construct multiplication table
   - Expanding basic multiplication facts through place value

3. Developing multiplication algorithm
   - Depends on the distributive property of multiplication over addition
   - Begin with examples that do not involve renaming and apply basic multiplication facts
   - Use the longer form of the multiplication algorithm to develop understanding
   - Teach the concept of renaming in multiplication

4. Developing division concepts
   - Help children visualize, understand, and record division using real-world experiences
   - Models to introduce division: groups of objects, arrays, number lines, repeated subtraction
• Two division situations: grouping (measurement division) and sharing (partition division)

5. Developing and memorizing basic division facts
• Division as the inverse operation of multiplication
• Use the multiplication table
• Division by zero

6. Developing division algorithm
• Expand basic division facts through place value
• Division of a two-digit number by a one-digit number – putting together a basic fact and an expanded basic fact
• Extend division concepts using models, introducing techniques of estimating quotients

7. General teaching points
• Use every day situations/story problems to develop meanings for the operations and use developmentally appropriate manipulatives
• Link presentation of algorithms to concrete models and situations
• Make sure students have appropriate understanding of the concepts before introducing the algorithms
• Stress number sense and estimation skills – show students ways to judge the reasonableness of their answers
• Encourage communication; let pupils explain or defend their procedures
• Make it clear to the students that there can be more than one procedure