Mathematical Processes

This document explains the mathematical processes.

Supporting Kindergarten

April 2011

Mathematical Processes

The Kindergarten Mathematics curriculum includes the seven processes identified by the Western and Northern Canadian Protocol (WNCP) as being inherent in the teaching, learning, and doing of mathematics. These processes focus on: communicating, making connections, mental mathematics and estimating, problem solving, reasoning, and visualizing along with using technology to integrate these processes into the mathematics classroom to help children learn mathematics with deeper understanding.

Bracketed letters following each outcome indicate those processes that are most important in the children's learning of the outcome. Teachers should carefully plan to make use of those processes indicated in supporting student achievement of the outcomes.

Communication [C]

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Bracketed letters following each outcome indicate those processes that are most important in the children's learning of the outcome. Teachers should carefully plan to make use of those processes indicated in supporting children's achievement of the outcomes.

Concrete, pictorial, symbolic, physical, verbal, written, and mental representations of mathematical ideas should be encouraged and used to help children make connections and strengthen their understandings.

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Connections [CN]

Contextualization and making connections to the experiences of learners are powerful processes in developing mathematical understanding. When mathematical ideas are connected to each other or to other real-world phenomena, children begin to view mathematics as useful, relevant, and integrated.

The brain is constantly looking for and making connections. Learning mathematics within contexts and making connections relevant to learners can validate past experiences and prior knowledge, and increase children's willingness to participate and be actively engaged.

Mental Mathematics and Estimation [ME]

Mental mathematics is a combination of cognitive strategies that enhance flexible thinking and number sense. It is calculating mentally and reasoning about the relative size of quantities without the use of external memory aids. Mental mathematics enables children to determine answers and propose strategies without paper and pencil. It improves computational fluency and problem solving by developing efficiency, accuracy, and flexibility.

Estimation is a strategy for determining approximate values of quantities, usually by referring to benchmarks or using referents, or for determining the reasonableness of calculated values. Children need to know how, when, and what strategy to use when estimating. Estimation is used to make mathematical judgements and develop useful, efficient strategies for dealing with situations in daily life.

Problem Solving [PS]

Learning through problem solving should be the focus of mathematics at all grade levels. When children encounter new situations and respond to questions of the type, "How would you ...?", "Can you ...?", or "What if ...?", the problem-solving approach is being modelled. Children develop their own problem-solving strategies by being open to listening, discussing, and trying different strategies.

In order for an activity to be problem-solving based, it must ask children to determine a way to get from what is known to what is sought. If children have already been given ways to solve the problem, it is not problem solving but practice. A true problem requires children to use prior learnings in new ways and contexts. Problem solving requires and builds depth of conceptual understanding and student engagement.

Problem solving is a powerful teaching tool that fosters multiple and creative solutions. Creating an environment where children actively look for, and engage in finding, a variety of strategies for solving problems empowers children to explore alternatives and develops confidence, reasoning, and mathematical creativity.

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Reasoning [R]

Mathematical reasoning helps children think logically and make sense of mathematics. Children need to develop confidence in their abilities to reason and explain their mathematical thinking. High-order inquiry challenges children to think and develop a sense of wonder about mathematics.

Mathematical experiences in and out of the classroom should provide opportunities for children to engage in inductive and deductive reasoning. Inductive reasoning occurs when children explore and record results, analyze observations, make generalizations from patterns, and test these generalizations. Deductive reasoning occurs when children reach new conclusions based upon what is already known or assumed to be true.

Visualization [V]

The use of visualization in the study of mathematics provides children with opportunities to understand mathematical concepts and make connections among them. Visual images and visual reasoning are important components of number sense, spatial sense, and logical thinking. Number visualization occurs when children create mental representations of numbers and visual ways to compare those numbers.

Being able to create, interpret, and describe a visual representation is part of spatial sense and spatial reasoning. Spatial visualization and reasoning enable children to describe the relationships among and between 3-D objects and 2-D shapes including aspects such as dimensions and measurements.

Visualization is also important in the children's development of abstraction and abstract thinking and reasoning. Visualization provides a connection between the concrete, physical, and pictorial to the abstract symbolic. Visualization is fostered through the use of concrete materials, technology, and a variety of visual representations as well as the use of communication to develop connections among different contexts, content, and representations.

Technology [T]

Technology tools contribute to student achievement of a wide range of mathematical outcomes, and enable children to explore and create patterns, examine relationships, test conjectures, and solve problems. Calculators, computers, and other forms of technology can be used to:

- explore and demonstrate mathematical relationships and patterns
- organize and display data
- extrapolate and interpolate
- assist with calculation procedures as part of solving problems
- decrease the time spent on computations when other mathematical learning is the focus
- reinforce the learning of basic facts and test properties
- develop personal procedures for mathematical operations
- create geometric displays
- simulate situations
- develop number sense
- develop spatial sense
- develop and test conjectures.

Technology contributes to a learning environment in which the growing curiosity of children can lead to rich mathematical discoveries at all grade levels. In Kindergarten, children can use computer software programs to explore literacy and numeracy. Technology may be used by Kindergarten children to create patterns and develop spatial awareness. Children in Kindergarten are expected to explore a variety of topics through the use of technology.

It is important for children to understand and appreciate the appropriate use of technology in a mathematics classroom. It is also important that children learn to distinguish between when technology is being used appropriately and when it is being used inappropriately. Technology should never replace understanding, but should be used to enhance it.