

mathematical processes, concepts, and symbols into meaningful counting experiences, dramatic play activities, games, rhymes, songs, finger plays, stories, and literature.

*When counting the days until a trip, the educator chooses to count the days using five as the anchor because it is a number that most children can understand and relate to. She puts sticky notes over five squares on a 5 frame with the numbers 5, 4, 3, 2, 1 printed on each note. As children count down each day, they remove a sticky note. Children then see the blank square and the remaining numerals.*

Each day, the children in this scenario see variations on the partitioning of five, see the numerals in the context of the count, and they count backwards in a way that is similar to using a number line. The educator's strategy is a more effective and meaningful way of showing the passage of time than using the calendar, which is abstract.

Writing numerals needs to occur in the context of an experience, (writing bills in the class restaurant, recording the blocks used in a structure, recording the count in a measurement experience). In other words, there needs to be a purpose or connection to writing the numerals. It is not a meaningless printing or colouring activity.

The big idea for kindergarten educators then, is to more conscientiously connect children's natural play experiences to the more formal language and symbolism of mathematics. The kindergarten environment should be filled with materials readily available to promote mathematical inquiry. (These materials may include numerals, found and commercial materials for sorting and classifying, scales and other measuring devices for sand and water play, blocks of all shapes and

sizes, containers that promote comparisons and counting, etc.) For example, *Rochelle brought her shell collection today and Ruman brought his stone collection. I wonder how many there are in each collection. How we could find out?"*

Copies of homemade or commercial hundreds boards, big enough for children to count out their treasures, are essential to capture teachable mathematical moments for sorting and counting collections. As children have alphabet strips at the writing centre, they should also have number lines which they may use when they are unsure how to make a particular numeral, or as a strategy for counting objects. Five and ten frames, dot cards and dot plates should also be readily available in order to continually develop the anchors of the numbers five and ten.

Kindergarten educators can capitalize on young children's natural interest in counting, comparing, measuring, moving their bodies in interesting patterns through space, and creating unique buildings using various shapes and sizes of materials. Since children are naturally inclined toward mathematics, it is relatively easy to embed formal mathematics into their play activities. However, educators need to conscientiously talk with children to make the essential links to the mathematics in school.

### **Disposition: Why does attitude matter? What might affect disposition?**

The ETFO kindergarten document *Kindergarten Years: Learning Through Play, 2000*, suggests establishing a 'climate of delight' in the kindergarten program.<sup>5</sup> In *Early Learning for Every Child Today (ELECT)*, play is seen "as a means to early learning that capitalizes on children's natural curiosity and exuberance".<sup>6</sup> In the Ontario Kindergarten Program play is seen as

a vehicle for learning “that provides opportunities for learning in a context in which children are at their most receptive”.<sup>7</sup>

This attention to disposition, natural curiosity, and receptivity for learning that is so evident in play-based learning, is at the heart of effective early education. Lilian Katz identified four interrelated types of learning that co-exist in any learning situation: knowledge, skill, feelings, and dispositions.<sup>8</sup> Disposition is the ‘habits of mind’ that become internalized. This quality is particularly relevant to solving problems in mathematics.

Dr. Douglas Clements identifies the disposition or habit of mind important for mathematics learning as: curiosity, willingness to persevere, imagination, willingness to experiment, and sensitivity to patterns which are all part of quality early childhood programs.<sup>9</sup> Interest, rather than cognitive ability, has been shown to be the best predictor of ability, along with more challenging comprehension tasks such as those associated with mathematical problem solving.<sup>10</sup>

Many factors are associated with creating interest and motivation for learning, including novelty, saliency, prior knowledge, and emotions relative to a particular task, as well as natural ability or inclination.<sup>11</sup> With respect to the latter, Howard Gardner’s multiple intelligence theories would suggest that children with strong logico-mathematical intelligence would have more natural ability and likely more positive attitudes and intrinsic motivation toward mathematical learning than other children, (just as some children are more naturally inclined toward language/literacy, music, bodily kinesthetic tasks, etc.)<sup>12</sup> The most effective motivators are relevance and novelty, supported by the confidence of successfully completing challenges that are closely matched to children’s current level of understanding and skill.

However, some strands of mathematics might indicate different intelligences. For example, geometry could be more related to visual-spatial than to logico-mathematical ability. Counting and recalling the names for specific number symbols could be more related to linguistic intelligence.

Children can be motivated to learn mathematics through their strength in another intelligence. Some children may engage in learning to count through music, chants, or ball bouncing activities. Others may more easily learn about geometry and spatial orientation through bodily kinesthetic activities. For the socially-motivated, learning mathematics through games and dramatic play may be most engaging. Some may learn to explore mathematical concepts and symbols through literature and/or technology. To motivate children to learn mathematics, educators must take into account all of these child-centered possibilities.

Several educator-related factors also contribute to the child’s disposition to learn mathematics. Educators who are effective mathematics educators communicate the enjoyment of learning mathematics, and have fun with mathematical challenges and discussions. They value errors as essential information that help them learn more.<sup>13</sup> These educators:

- help children understand the purpose of learning math;
- set realistic and interesting challenges related to mathematics;
- provide children with open-ended activities that allow them to apply their understanding at an appropriate developmental level;
- create math-rich classroom environments;
- talk with children about their mathematical discoveries and ideas; and
- help children learn to evaluate their responses.

Educators need a clear understanding of how children come to know and understand mathematics in the early years. Documents such as *First Steps*<sup>®</sup>