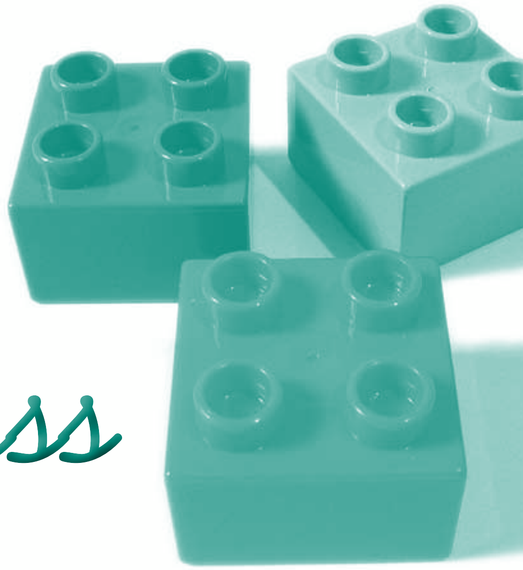
Understanding conservation: *A playful process*



MARY-ANNE KEFALOUKOS and JANETTE BOBIS discuss the importance of introducing conservation in measurement through the use of play in the early years of school

Measurement is a strand that has the capacity (no pun intended) to make or break a child's confidence in mathematics. It contains a multitude of interrelated concepts that force logical and lateral thinking, both of which need a person's experience to underpin their use (NSW DET, 2004). Children are limited in their experiences already due to their age, but classroom experiences do not have to discriminate for age. Teachers can begin to develop young students' conceptual understanding of conservation of quantity and mathematical language by allowing them the opportunity to play. Students' playful investigations will form the prior knowledge needed for practical investigations in the later years of learning in measurement (Hunting, 2010; Rogers, 2000).

In this article, some aspects of Piaget's Theory of Cognitive Development will be described. It is not our intention to disprove or ratify Piaget's theory which states that "preoperational" children are not yet intellectually mature to understand conservation principles (Berk, 2003). Rather, the article highlights the importance of giving young children specific access to explore conservation in measurement, which will give students invaluable experiences in measurement that in years to come will be regarded as their prior knowledge of the concept. This will be explored through the discussion of the complex nature of conservation and the benefits of play, with the integration of the two elements in the practical teaching suggestions. The anticipated result will be a decrease in misconceptions and an increase in enthusiasm and curiosity towards measurement concepts (by both students and teachers).

"Conservation" is a term constructed by Jean Piaget, which describes a child's understanding that the quantity of an object is unchanged, even if it is rearranged (Gough, 2008; NSW DET, 2003). For example, there is the same amount of sand on the table whether it is shaped like a small mountain, or whether it is spread out thinly. Likewise, the child understands that the mountain-like shape can be inverted and the amount of sand will still remain the same. According to Piaget, there is an appropriate time to incorporate the principle of conservation into mathematical learning, which is after students turn seven years of age. According to his theory of cognitive development, a typical child between the ages of two and seven thinks centrally, that is, the child is unable to comprehend a perception that goes deeper than the superficial appearance (Berk, 2003). However, Donaldson (1984), in questioning the methodology of Piaget's experiments, describes a study where 70 per cent of young children were found to be conservers, markedly different to Piaget's findings. So there is precedence for educators to consider the capabilities of young children in the field of conservation.

Conservation of mass is an important measurement principle, or 'big idea,' as it interconnects many aspects of the measurement strand, such as mass, volume, capacity and length (Hunting, 2010, p. 729; NSW DET, 2004). In the Australian Curriculum and NSW syllabus documents, we encounter the need for understanding conservation in Stages 2 and 3 (that is, Years 3 to 6 or children aged approximately 8 to 12 years) as students proceed to use formal measurement units (ACARA, 2011; NSW BOS, 2002). For instance, in measuring the length of objects whose shapes can be changed (such as string when it is stretched out and when it is rolled up), in measuring the area of a shape (such as a square of paper cut to make a long rectangle, which has the same area as the square), and, in Figure 1, when measuring capacity (NSW DET, 2003). Whilst the NSW Department of Education and Community argues that conservation is not a prerequisite for measurement, but arises from measuring activities, play presents an opportunity for children to deal with these big ideas, discuss, raise a question or observe and record for later.

Figure 1. Wide versus tall cups with the same amount of water.

Another reason for introducing conservation early is to help address any misconceptions that might arise. The interconnectedness that conservation creates in measurement may be problematic as variables are introduced. For example, a misconception could be that the bigger the size, the heavier the object, which interferes with the learning of volume. It seems futile to try to debunk these misconceptions at an early age with explicit teaching. However, it is crucial that children are given the opportunity to question the principle of conservation of mass, as the visual representations children form from these experiences can be called upon in later years. Such early experiences will assist their problem solving skills, and can be used to help overcome misconceptions (Rogers, 2000).

A pedagogical approach that seems most suitable to introduce a complex, yet necessary, concept to students involves the use of 'play'. Docket and Perry (2010), in considering the definition of play in a contemporary context, describe play as a disposition of the student, as opposed to meaning the type of materials that are used in the play activity. Play is perceived as a limitless ground for a number of mental processes of the participants, such as questioning and predicting, and could lead participants to a change of conceptions as their experience informs their new constructions of knowledge (Dockett & Perry, 2010).

Play provides a memorable experience for children—anyone can attest to this. Simply ask a child how school was, and playtime is what they talk about most often. Children in play use many facets of their intelligence at the same time, and usually unknowingly (Casby, 2003). They can engage with 'big ideas' without the feeling of 'information overload', which can sometimes be felt during teacher explanations of complex concepts. However, the teacher does have a role in guiding young students' experiences in play. Donaldson's (1984) understanding of the influence of children's interpretations on questions suggests that questioning by the teacher, used wisely, can guide the child on the path of 'decentering' and conserving.

The following suggestions of play activities can be utilised for any young child, in any curriculum context (that is, State, national or international), as conservation is a phenomenom that occurs in any context, regardless of place or language spoken. Also, the resources can be made or borrowed from home, and thus are cost-effective. Activities can be implemented in 'stations', with many activities going on at the one time in the classroom. Each activity can be observed for children's understanding, photographed or video-recorded for teacher reflection of the suitability of the activity, or for records to show the progression of each child's understanding from Foundation to Year 6. Activities are not restricted to these as they are a sample; teachers can build upon these to make other activities related to conservation principles. The play activities below are suggestions to introduce children to the overarching principle of conservation: distortion of an object's shape does not change the object's quantity.

More or less sand?

Equipment:

- a few cupfuls of soft sand
- a table or flat surface
- newspaper for the floor or a broom and dustpan (for cleaning).

Figure 2. Experiences with sand can form the basis of an understanding of conservation as sand is spread thinly or is made into 'castles'.

Figure 3. Play dough is cost effective and limits mess in the classroom; it is easy for young children to physically manipulate.

Two or three students sit or stand around the table playing as they might in a sand pit. Ask the questions: "Is there the same cupful of sand in a pile as there is when you spread the sand out? What about when you go from sand that is spread to a pile?" The aim is to develop children's understanding that a thinly spread out substance can be condensed into a pile, and whilst appearing smaller, is actually the same amount of substance.

Play dough play time

Equipment:

- play dough (same amount given to each student)
- rolling pins
- flat surface

As children make different shapes with their play dough, discuss with children whether their long shapes require more play dough than their spheres, chunks of play dough, or flat rolled-out play dough. Listen to their answers and if needed, remind students that you gave them the same amounts of play dough at the start, so if they used all the play dough, then the amounts are still the same after they have changed the shape. Ask a pair of children to compare the amount of play dough they have each been given (which you have craftily made sure is the same). Ask: "Did I give you both the same amount of play dough? How do you know?"

Tall towers

Equipment:

- construction blocks all of one size and shape (possibly all base ten longs or multilink cubes)

Give individuals, pairs or small groups of students the same number of blocks to build towers of different shapes around the classroom. Leave students unaware that they have been given the same number of blocks. While students are constructing their towers,

Figure 4. Uniform-sized blocks help students to explore conservation of mass principles as the unit block can be counted when comparing block models.

ask if a tall tower needs more blocks than a short, wide tower. Post-play, ask students to order their towers from the least amount of blocks to the most, and observe how students make their arrangements—whether they count the blocks, or look at the dimensions of the tower as a whole.

As children engage with the activities in a play situation while having their thinking guided by informal teacher questioning, they are building their thought processes for the future—retaining visual and tactile memories of the principle of conservation without even realising it. The early years are the right time for students to engage with complex mathematical concepts through play, assisting with the development of understanding of interrelated measurement concepts which will be necessary in the later years of schooling.

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