Preschool and School Educators Noticing Young Children's Mathematics

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This paper reports on how one of the major outcomes from a long term mathematics education professional development project involving educators from preschools and the early years of school in South Australia is being used by these educators to notice young children's mathematics. The educators use *Reflective Continua* to guide their reflection and planning for this learning. The paper explores the use of learning stories as a link between the *Reflective Continua*, the educators' noticing of children's mathematics and both the strands and competencies of the new *Australian Curriculum – Mathematics* and the outcomes of the *Early Years Learning Framework for Australia.*

Australia has recently experienced a curriculum revolution in early childhood education in general, and mathematics education, in particular. Both the *Early Years Learning Framework for Australia (EYLF)* (Department of Education, Employment and Workplace Relations (DEEWR), 2009) and the *Australian Curriculum – Mathematics (AC-M)* (Australian Curriculum, Assessment and Reporting Authority (ACARA), 2011) recognise the scope and importance of the powerful mathematical ideas young children bring with them to primary school. The *EYLF* (DEEWR, 2009, p. 38) lists these ideas as:

> Spatial sense, structure and pattern, number, measurement, data, argumentation, connections and exploring the world mathematically are the powerful mathematical ideas children need to become numerate.

Similar ideas are reflected in the strands and competencies of the *AC-M* (ACARA, 2011): number and algebra; measurement and geometry; statistics and probability; understanding; fluency; problem solving; and reasoning.

The *AC-M* strands and competencies have been used by educators from South Australian preschools and schools to develop an instrument - the *Reflective Continua* - designed to assist such educators to notice children's mathematics and to plan for further mathematical experiences. The *Reflective Continua* consist of a set of seven interactive tables – one for each of the strands and competencies in the *AC-M*. (The *Reflective Continua* can be directly linked to the *EYLF* outcomes via the *Numeracy Matrix* which was also developed in the same professional development project. Details of how this can be done have been provided in earlier publications (Harley, Perry, & Dockett, 2007; Perry, Dockett, & Harley, 2012)). Each *Reflective Continuum* highlights a progression of development and engagement with the relevant powerful mathematical idea. Details about the development of the *Reflective Continua* are provided in Perry and Dockett (in press).

Four levels of learning development and engagement: emerging, investigation, application, and generalisation are used to demonstrate children's progression throughout the *Reflective Continua.* An example of one continuum is shown in Table 1.

In V. Steinle, L. Ball & C. Bardini (Eds.), Mathematics education: Yesterday, today and tomorrow (Proceedings of the 36th annual conference of the Mathematics Education Research Group of Australasia). Melbourne, VIC: MERGA.

Table 1
Reflective Continuum – Measurement and Geometry

Emerging	**Investigation**	**Application**	**Generalisation**
Uses mathematical language without making comparisons of measurable attributes Incidentally compares measurement attributes Shows awareness of space as it relates to one's movement Describes their own position in their environment using words such as 'over', 'under', 'beside', etc Example 1: Leon Example 2: Sol Example 3: Kamal	Investigates the use of units in the measurement process Uses relevant non-standard units to measure through comparing, counting and describing the results in appropriate language Sorts objects according to shape Investigates properties of shapes and the ways they can be manipulated Explores understandings of directional language and mapping Example 1: Eliza Example 2: Bolek Example 3: Dani	Applies knowledge of the measurement processes to estimate and measure using standard units Applies knowledge of shape and space to help them communicate aspects of their own lives and environment Describes position in relation to surroundings Creates and uses visual representations of various environments Example 1: Fatima Example 2: Ester Example 3: Clarissa	Transfers the understanding of measurement processes using standard units to measure various attributes of an object Uses directions and/or landmarks to plan and describe a journey Employs (mental) visualisation of shapes to solve problems Example 1: Corbie Example 2: Lexie Example 3: Thein

Each continuum lists 'behaviours' that might be expected to be demonstrated by children at each of the levels, along with hyperlinks to examples of how such behaviours might appear in both preschools and first years of school. Most of these examples are learning stories that emanate from real children and real educators. *Learning stories* (Carr & Lee, 2012) go beyond work samples in that they are recorded as structured written narratives, often with accompanying photographs that document and communicate the context and complexity of children's learning. They also include relationships, dispositions, and an interpretation by someone who knows the child well (Carr & Lee, 2012). Learning stories acknowledge young children's learning, educators' pedagogy, and the context in which the learning takes place. They are often used by educators to plan for future, ongoing learning (Perry, Dockett, & Harley, 2007).

Two learning stories used in the Measurement and Geometry continuum are shown in Figures 1 and 2.

Sol went over to the toy tray and pulled out the stacking cups. Very carefully with lots of balance she began to stack the cups in sizes. She tried different sizes at first realising a smaller cup would disappear inside a larger one. With trial and error she built a big tower. Sol is showing reflective thinking and problem solving skills which are basic numeracy skills. We could extend her numeracy skills by introducing basic shapes.

Figure 1. Emerging Level Measurement and Geometry: *Incidentally compares measurement attributes* Work Sample

Today we gave the children the opportunity to measure shapes with some non standard units of measurement – pebbles, seed pods, shells and dried beans. The children enjoyed chatting to each other about how many of the resources were needed to go around the perimeter of each shape. Once they had measured with one of the resources they would choose another and compare their results. The children were encouraged to record their findings and they did this by writing down the number of shells, pebbles etc they had used and then they drew the shape they had measured. It was interesting to note that they then started to form patterns around the perimeters of the shapes using the pebbles, pods, shells and beans. Bolek went out into the garden and found sticks and rosemary twigs and they used these to measure around the shapes showing that they had an understanding of the fact that many things can be used to measure. The children also noticed that more small objects and less large objects were required to measure the perimeter of a given shape.

Figure 2. Investigation Level Measurement and Geometry: *Uses relevant non-standard units to measure through comparing, counting and describing the results in appropriate language* Learning Story

In both of these learning stories, educators notice the mathematics with which children are engaging and use their analysis of what they see for future planning. All four levels of all seven *Reflective Continua* tables contain at least two work samples/learning stories illustrating what might be expected of children working at these levels. While this collection brings together much practical wisdom and experience from the educators involved, the examples are not meant to be fixed. Educators who are using the *Reflective Continua* have been encouraged to substitute their own learning stories so that the instrument becomes even more relevant to them and their children. Figure 3 shows one example that was noticed by an educator and now is part of her modified *Reflective Continua.* She plans to continue such modifications as she notices even more the mathematics with which her children are engaged.

Play-dough People

With great effort Eliza rolled and rolled the dough to make 'snake' appendages. She lay 6 of them out on the table then compared their lengths. 'Two here and two there, hmmm and one up and one down'. She put the longest two together then stretched one of them to match the other (legs); was happy with the length of the arms; and deliberated with the other two pieces. One became the hair and she inverted the other to become the bottom of her face.

Figure 3. Emerging Level Measurement and Geometry: Incidentally compares measurement attributes Learning Story

Conclusion

The *Reflective Continua* are being used by preschool and first years of school educators to help them notice, reflect on and plan for future mathematics learning by young children. We are beginning to see educators develop their own confidence to the extent of substituting their own learning stories for those provided. Not only is this making the *Reflective Continua* more relevant to the educators and children but it is providing sound professional learning experiences in the importance of noticing children's mathematics. A planned state-wide dissemination of the *Reflective Continua* in 2013 should extend this important influence on educators' practice.

References

Australian Curriculum, Assessment and Reporting Authority (ACARA). (2011). *Australian curriculum – Mathematic*s. Canberra: Author.

Carr. M., & Lee, W. (2012). *Learning stories: Constructing learner identities in early education*. London: Sage.

Department of Education, Employment and Workplace Relations (DEEWR). (2009). *Belonging, being & becoming: The early years learning framework for Australia*. Canberra: Commonwealth of Australia.

Harley, E., Perry, B., & Dockett, S. (2007). Early childhood educators celebrating and assessing young children's powerful mathematical ideas. *Journal of Australian Research in Early Childhood Education, 14*(2), 83-94.

Perry, B., & Dockett, S. (in press). Reflecting on young children's mathematics learning. In L. English & J. Mulligan (Eds.), *Reconceptualizing early childhood mathematics*. Dordrecht: Springer.

Perry, B., Dockett, S., & Harley, E. (2007). Learning stories and children's powerful mathematics. *Early Childhood Research and Practice, 9*(2). Retrieved from: http://ecrp.uiuc.edu/v9n2/perry.html

Perry, B., Dockett, S., & Harley, E. (2012). The Early Years Learning Framework for Australia and the Australian Curriculum – Mathematics: Linking educators' practice through pedagogical inquiry questions. In B. Atweh, M. Goos, R. Jorgensen, & D. Siemon (Eds.), *Engaging the Australian Curriculum Mathematics: Perspectives from the field* (pp. 153-174). Adelaide, SA: Mathematics Education Research Group of Australasia. Retrieved from http://www.merga.net.au/onlinebooks