Early Childhood Mathematics Education Research: What is Needed Now?

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In the last four years there have been a number of calls for research into many aspects of early childhood mathematics education. As well, there has been an unprecedented increase in Australasian research in this field. How have these two factors matched? That is, are mathematics education researchers studying the aspects of the field that have been identified for further research? This paper provides the beginnings of a discussion around this question by highlighting particular Australasian early childhood mathematics education research endeavours and linking them to recent statements calling for further research in the field.

In our chapter for the recent MERGA review of research in mathematics education research in Australasia (Perry & Dockett, 2004), we concluded with the following statement on future research in early childhood mathematics education.

> From this critique of early childhood mathematics education research in Australasia in the period 2000 – 2003, fruitful areas for future research would seem to include:
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> - approaches to assessment and teaching / learning in numeracy and possible mismatches between these;
> - successful approaches to the mathematics education of young Indigenous students;
> - successful approaches to the mathematics education of young children from culturally and linguistically diverse backgrounds;
> - technology in the mathematics education of young children;
> - play in the mathematics education of young children;
> - development of mathematical concepts among children before they start school;
> - continuities and discontinuities of learning in children as they move from prior-to-school to school settings, and
> - recognition of young children as capable learners of mathematics and the results of such recognition in their mathematical outcomes in the first years of school.
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> The field of early childhood mathematics education research beckons as an exciting forum in which committed researchers can make a difference. While a lot has already been done, there is still much to do in an area which has been neglected to some extent but which is now enjoying a resurgence of interest. (pp. 119-120)

Similar statements have been made in other contexts. For example, Ginsburg and Golbeck (2004, p. 190)

> argue that researchers and practitioners should examine carefully not only the possibility of unexpected competence in young children, but also its complexity and the limits on it; investigate the socio-emotional context of learning and teaching; attend closely to those children in need of extra help, including low-socio-economic status (SES) children, children with disabilities, and children who receive schooling in an unfamiliar language; create sensitive evaluation strategies that examine program quality, the effectiveness of teachers and administrators, and children's achievement; develop creative and enjoyable curricula that stress thinking as well as content and integrate an organized subject matter with projects and the thoughtful use of manipulatives; investigate the complex processes of teaching in various contexts; and investigate the possible benefits and disadvantages of parental involvement in early mathematics and science education.

Clearly, there are many similarities in these two statements. Together, they can be taken to articulate an agenda for further early childhood mathematics education research.

The latest comprehensive review of this research in Australasia (Perry & Dockett, 2004, p. 119) suggests that

> there is a vibrant and important early childhood mathematics research agenda in Australasia. Growing worldwide recognition of the importance of the early childhood years – both in and of themselves and in preparation for future learning experiences – and of the valuable, innovative and critical research being undertaken in Australasia augurs well for growth and continued influence.

How are we Travelling?

It is particularly gratifying to be able to report that, over the last 4 years since this statement was made, the quantity and quality of early childhood mathematics education research in Australasia have both moved in very positive directions. Much of this research has been stimulated by large systemic numeracy programs. Bobis, Clarke, Clarke, Thomas, Young-Loveridge, & Gould (2005) provide a comprehensive comparison of these programs) such as *Count Me In Too* (Bobis & Gould, 2000), *Early Numeracy Research Project* (Clarke & Clarke, 2004; Clarke, Clarke, & Cheeseman, 2006), and *First Steps* (Willis, Devlin, Jacob, Treacy, Tomazos, & Powell, 2004) in Australia and the *Early Numeracy Project* in New Zealand (Thomas, Tagg, & Ward, 2003). Based on the pioneering work of Bob Wright (e.g., Wright, 1994; Wright, Martland, Stafford, & Stanger, 2002), these programs have revolutionised early numeracy teaching and learning in Australia and provided a great deal of stimulus for further research in early childhood mathematics education.

The lists of "needed" research compiled by Ginsburg and Golbeck (2004) and Perry and Dockett (2004) are extensive. It is well beyond the scope of this paper to report on achievements in each of the areas listed. Rather, as examples, we choose two areas in which a great deal of work has been done by Australasian mathematics education researchers. These promote the central tenet of this paper that much has been done but that there is still much to do.

Young Children are Capable Mathematics Learners

One area identified above in terms of further research that has been carefully considered by these systemic programs has been that of recognition of young children as capable learners of mathematics and how this recognition impacts on the curriculum and pedagogy of the first years of school. The notion that children come to school able to access powerful mathematical ideas is not new but has received renewed emphasis through several initiatives in Australasia and beyond. For example, the recently published *Position Paper on Early Childhood Mathematics* (Australian Association of Mathematics Teachers and Early Childhood Australia (AAMT/ECA), 2006, p. 2) states that:

> The Australian Association of Mathematics Teachers and Early Childhood Australia believe that all children in their early childhood years are capable of accessing powerful mathematical ideas that are both relevant to their current lives and form a critical foundation for their future mathematical and other learning. Children should be given the opportunity to access these ideas through high quality child-centred activities in their homes, communities, prior-to-school settings and schools.

Research in Australasia (Clarke et al., 2006; Perry, Dockett, Harley, & Hentschke, 2006; Thomson, Rowe, Underwood, & Peck, 2005; Young-Loveridge, 2004) and

beyond (Aubrey, 1993; Aubrey, Dahl, & Godfrey, 2006; Sarama & Clements, 2004; Seo & Ginsburg, 2004) provides backing for this profoundly important statement. Many of the systemic numeracy programs mentioned earlier in this paper adhere to this position and reflect it in the ways that they assess their participants in order to ascertain the extent to which the powerful ideas are present.

Assessment in Early Childhood Mathematics Education

Prior to the publication of the Australian position statement on early childhood mathematics education (AAMT/ECA, 2006), the peak professional bodies in mathematics and early childhood education in the United States of America had published their own position statement (National Association for the Education of Young Children and National Council of Teachers of Mathematics (NAEYC/NCTM), 2002). Assessment of young children's mathematical learning features as one of the critical elements of high quality mathematics education. The following statement is included:

> Assessment is crucial to effective teaching. Early childhood mathematics assessment is most useful when it aims to help young children by identifying their unique strengths and needs so as to inform teacher planning. Beginning with careful observation, assessment uses multiple sources of information gathered systematically over time. … Mathematics assessment should follow widely accepted principles for varied and authentic early childhood assessment. For instance, the teacher needs to use multiple assessment approaches to find out what each child understands--and may misunderstand. Child observation, documentation of children's talk, interviews, collections of children's work over time, and the use of open-ended questions and appropriate performance assessments to illuminate children's thinking are positive approaches to assessing mathematical strengths and needs. (NAEYC/NCTM, 2002, pp. 12-13).

The Australian position statement suggests that

> Early childhood educators should adopt pedagogical practices that assess young children's mathematical development through means such as observations, learning stories, discussions, etc. that are sensitive to the general development of the child, their mathematical development, their cultural and linguistic backgrounds, and the nature of mathematics as an investigative, problem solving and sustained endeavour. (AAMT/ECA, 2006, p. 3)

Clearly, assessment of mathematics learning is an important part of early childhood mathematics education. There has been and continues to be a great deal of work in Australasia in this area. For example, the work of Doig and his colleagues (Doig, 2005; Thomson et al., 2005) has developed and used standardised approaches to assessment that are claimed to have highly valid and reliable statistical characteristics, making them very useful in large scale reporting. Mulligan and her colleagues (Mulligan, Prescott, Papic, & Mitchelmore, 2006) have developed a particular assessment approach, based on those used in *Count Me In Too* and other systemic numeracy projects, to assess the development of pattern and structure in young children. Fox (2006) has used extensive structured observations to study possible links between patterning activities and the development of algebraic reasoning in preschool children. Young-Loveridge and her colleagues (Young-Loveridge, 2004; Young-Loveridge & Peters, 2005) have used individual task-based interviews to assess the numeracy development of children across the early childhood years and to evaluate the effectiveness of many different teaching approaches. Perry and his colleagues (Perry et al., 2006; Perry, Dockett, & Harley, in press) have used the learning stories approach developed by Carr (2001) and linked it to an extensive numeracy matrix constructed jointly by researchers and practitioners to assess and plan for preschool children's mathematical learning within the context of a mandatory

reporting regime. All of these approaches to assessment show great potential to further enhance young children's mathematical learning and the teaching that will facilitate this.

Conclusion

There are many further examples where Australasian early childhood mathematics education researchers have taken up the challenge to undertake research that has been identified through the literature as 'needed'. More needs to be done but much has been achieved. For example, there is a particular need for practice-based research on ways in which culturally and linguistically diverse learners might better engage with mathematics education in both prior-to-school and school settings. One possible approach that could be applied to mathematics education has been documented by Fleer and Kennedy-Williams (2002). Much has been done in the area of technology use in early childhood mathematics education (Kilderry & Yelland, 2005) and the importance of continuity in approaches to mathematics learning and teaching as children make the transition to school has been recognised, although there is still a long way to go before this recognition results in practical changes (Thomson et al., 2005). The advent of documents such as the Australian position statement on early childhood mathematics education (AAMT/ECA, 2006) shows that the professions relevant to early childhood mathematics education are taking notice of the advances being made and the avenues being opened by this research. This recognition provides the early childhood mathematics education research community with strong motivation to continue its work.

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