

# Preschool Educators' Sustained Professional Development in Young Children's Mathematics Learning

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This paper investigates the effects of a sustained professional development project in South Australia in which a small group of preschool educators worked with the authors to develop their own knowledge and skills in facilitating young children's mathematical learning. Through the development of an approach to pedagogy that linked the mandated learning outcomes for preschools in South Australia to powerful mathematical ideas, the preschool educators have changed their practices in mathematics education and the ways in which they think about these practices. As well, implementation of a narrative assessment approach has provided opportunities not only for the enhancement of children's learning but also enhancement of the educators' mathematical knowledge and skills. After providing background about current research on effective pedagogy in preschools, the paper considers the impact of the professional development project on the early childhood educators, particularly in terms of their growth in knowledge, skills and confidence in early childhood mathematics.

In order to set the context for the study reported in this paper, three aspects of learning in preschools need to be canvassed in general before they are applied to the learning of mathematics in particular. These aspects are: the purpose of preschool education; preschool pedagogy; and assessment for learning.

## *Purpose of Preschool Education*

Worldwide focus on prior-to-school education has increased significantly in the past decade (Dahlberg & Moss, 2005; Organisation for Economic Cooperation and Development (OECD), 2001; Penn, 2002). Discussions of the role and purpose of prior-to-school education highlight a number of tensions. Traditionally, at least in Western contexts, prior-to-school education has been regarded as a context for children to engage with and explore their worlds, without pressure to engage in formal learning or instruction (Cuban, 1992; Seefeldt & Wasik, 2002). Early childhood educators have long resisted the push-down of academic curriculum and the notion that the value of prior-to-school education is located in its role of preparing children for later stages of education (Bertram & Pascal, 2002; Moss & Petrie, 2002), choosing instead to promote the value of children's learning through play, interaction and developmentally appropriate practice (Bredekamp & Copple, 1997).

In contrast to this view, much of the recent focus on prior-to-school education relates to economic considerations, with investment in prior-to-school education and intervention linked to future savings in terms of special education and rehabilitation services (Cleveland & Krashinsky, 2003; Dickens, Sawhill & Tebbs, 2006; Ludwig & Sawhill, 2006; Schweinhart, Barnes, & Weikart, 2005). Epitomising this view, McCain, Mustard, and Shanker (2007) indicate that “the roots of economic productivity and health risks in adulthood are found in early childhood” (p. 17).

A focus on developing young children’s academic preparedness for school impacts on perceptions of appropriate curriculum for prior-to-school services (Scott-Little, Kagan, & Frelow, 2003). One general outcome can be calls for more focused academic instruction during the years before school.

The idea that prior-to-school services, particularly preschool, serve the purpose of preparing children for school is not new. However, a renewed focus on the importance of preschool education leading into school has been evident in some recent Australian reports and policy documents, such as the *National Goals for Schooling* (Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA), 1999), and the *National Agenda for Early Childhood Draft Framework* (Commonwealth Task Force on Child Development, Health and Wellbeing, 2004) and the *National Preschool Education Inquiry Report* (Walker, 2004).

### *Preschool Pedagogy*

Whatever is seen as the prime purpose for preschools, there is always the question of how we can make them as successful as they can be. One powerful way of interpreting such ‘success’ is in terms of outcomes displayed by children. In recent work in British preschools, it has been found that the most effective settings (in terms of intellectual, social and dispositional outcomes) promoted a balance of teacher-initiated group work with freely chosen, yet potentially instructive play activities; promoted sustained shared thinking; and adopted social and behaviour policies that involved staff supporting children in rationalising and talking through conflicts (Siraj-Blatchford & Sylva, 2004). There was a significant relationship between higher quality preschools and intellectual and social outcomes. In early childhood settings with quality educational outcomes for children, the importance of achieving a balance between *pedagogical interactions* (specific behaviours on the part of adults) and *pedagogical framing* (the behind-the-scenes aspects of pedagogy which include planning, resources, and establishment of routines) has been identified (Siraj-Blatchford & Sylva, 2004; Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart, 2004). Achieving this balance required more than setting up an interesting environment to promote children’s play. Going beyond this to engage children in activities that provided cognitive challenge was essential. This involved educators identifying “critical moments” where there was potential to “lift the level of thinking” required of children through educators’ use of scaffolding, thematic conversation or instruction (Siraj-Blatchford & Sylva, 2004, p. 723). Despite the importance of this

engagement with children, it was reported to occur relatively infrequently, even in excellent services.

The principles underpinning effective pedagogy are linked to the beliefs and expectations of educators: "Effective pedagogy is based on informed knowledge and theories of early childhood development, education and care, including management and organisational factors" (Moyles, Adams, & Musgrove, 2002, p. 119). Further, "the key to effective pedagogy is the ways in which principles are established and the ways that theories of children's learning and development are applied to practice, informed by values, beliefs and understandings" (Moyles et al., 2002, p. 120). Preschool pedagogy is complex and this complexity is not always appreciated by early childhood educators. However, it is this very complexity that provides the stimulus for educators to reflect on their beliefs and practice with the aim of improving the educational experiences of their children.

### *Assessment for Learning*

Effective pedagogy in the early childhood years involves a range of appropriate assessment. Effective educators provide regular and realistic feedback to children, with the aim of providing cognitive challenge and facilitating progression in children's learning and development (Sylva et al., 2004). If educators are to be in the best possible position to facilitate their children's learning, then assessment for learning is of critical importance. In their definitive *Best Evidence Synthesis*, Anthony and Walshaw (2007) provide the following, contextually New Zealand, statement on the nature and importance of assessment in the early childhood years.

Assessment in the early years is seen as an integral part of learning: 'Assessment sits inside the curriculum, and assessments do not merely describe learning, they also construct and foster it' (Ministry of Education, 2004e, p. 3). The New Zealand early childhood exemplar document *Kei Tua o te Pae* describes assessment for learning as 'noticing, recognising, and responding': 'Teachers notice a great deal as they work with children, and they *recognise* some of what they notice as 'learning'. They will *respond* to a selection of what they recognise' (Ministry of Education, 2004e, p. 6). (Anthony & Walshaw, 2007), (p. 35)

Many early childhood educators utilise formative assessment (*assessment for learning*) to great effect in their everyday practice. Within early childhood pedagogies, some innovative forms of documentation, such as Learning Stories (Carr, 2001) and the Reggio Emilia approach (Rinaldi, 2006), have generated renewed interest and vigour in the area of formative assessment. However, accountability frameworks often emphasise summative assessment (*assessment of learning*), rather than formative assessment. Learning outcomes are often presented in terms of what children are expected to achieve or to demonstrate at the end of a particular year, stage, or phase of learning. One of the challenges of this focus is that: "summative assessments emphasise normative judgements and weightings that are usually predetermined by previous policy makers and educationalists" (British Educational Research Association Early Years Special

Interest Group (BERA-SIG), 2003, p. 26). In general, reliance on normative, standardised assessments is problematic in relation to young children (National Association of Early Childhood Specialists in State Departments of Education, 2000). Many standardised assessments do not recognise that young children can demonstrate skills and abilities in many different ways, and are not particularly sensitive to cultural and linguistic diversity (Bowman, Donovan, & Burns, 2001; Meisels, 1999; Scott-Little, Kagan, & Clifford, 2003).

## Early Childhood Mathematics Education

In 2006, the Australian Association of Mathematics Teachers (AAMT) and Early Childhood Australia (ECA) jointly published their position paper on early childhood mathematics (Australian Association of Mathematics Teachers and Early Childhood Australia (AAMT/ECA), 2006). There are many important and useful themes introduced in the Position Paper. Three of these themes are particularly pertinent to this paper.

The first theme echoes much of the work of Sylva et al. (2004) and Siraj-Blatchford and Sylva (2004), particularly in terms of the need for a balanced view of early childhood pedagogy. This theme recommends that

early childhood educators should adopt pedagogical practices that encourage young children to see themselves as mathematicians by stimulating their interest and ability in problem solving and investigation through relevant, challenging, sustained and supported activities. (AAMT/ECA, 2006, p. 2)

The second theme reflects the importance of assessment for learning by recommending that early childhood educators should

assess young children's mathematical development through means such as observations, learning stories, discussions, etc that are sensitive to the general development of the children, 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)

Taken together, these two themes strongly suggest how early childhood educators might facilitate children's mathematics learning through both learning and assessment.

A third theme from the position paper recommends that

Early childhood education providers should expect and support staff to undertake ongoing professional learning that develops their knowledge, skills and confidence in early childhood mathematics. (AAMT/ECA, 2006, p. 4)

It is well established that early childhood educators' mathematical knowledge and dispositions are key to effective mathematics learning in early childhood settings (Anthony & Walshaw, 2007; Haynes, Cardno, & Craw, 2007; Perry & Dockett, in press). It is also clear that "low levels of content knowledge and the resulting lack of confidence about mathematics limit teachers' ability to maximise opportunities for engaging children in the mathematical learning

embedded within existing activities (Anthony & Walshaw, 2007, p. 47). The need for ongoing professional learning for early childhood educators is emphasised by Perry and Dockett (2002):

At this time when children's mathematical potential is great, it is imperative that early childhood teachers have the competence and confidence to engage meaningfully with both the children and their mathematics. (pp. 104-105).

In this paper, we report on an evaluation of a sustained and supported professional development project in South Australia in which a small group of preschool teachers worked with the authors to develop their own competence and confidence in facilitating young children's mathematical learning through investigative approaches, and their own assessment of this learning through the use of learning stories (Carr, 2001). We use the three themes: young children as mathematicians; assessment of mathematical development; and professional learning to analyse the value of the project.

## The Southern Numeracy Initiative

The Southern Numeracy Initiative (SNI) was established in 2004 among five high schools, sixteen primary schools and six preschools in two districts south of Adelaide, South Australia. The aims of SNI included:

- to develop and implement successful teaching and learning practices to improve numeracy; and
- to challenge teachers to explore their beliefs and understandings about how children develop their understanding of mathematics, and how this can be supported through the teaching program.

The preschools in SNI (South Australia has sessional preschools universally available to all 4-year-olds) were concerned about the direction being taken by the schools involved, especially in terms of apparent tension between the formality of instruction and the methods of assessment chosen by the schools. As a consequence, the authors of this paper were invited to work with the preschool educators in SNI to develop a program aimed at improving teaching, learning and assessment practices in the numeracy development of young children. Commencing from a position that all children are powerful mathematical learners (Anthony & Walshaw, 2007; Thomson, Rowe, Underwood & Peck, 2005) and learners of powerful mathematical ideas (Ministry of Education, 1996; Perry & Dockett, 2002; Perry, Dockett, Harley, & Hentschke, 2006), the key research question for the SNI preschool project was: *How can the powerful mathematical ideas that are displayed by young children before they start school be recognised and celebrated in a valid manner within the context of a mandated reporting regime and a child-centred, play-based approach to learning?*

This research question operationalises many of the beliefs about mathematics and mathematics learning and teaching that are pertinent to what follows in this paper:

- young children are powerful mathematics learners;

- recognition and assessment of these powerful mathematical ideas are tasks that many early childhood educators find difficult; and
- the current child-centred, play-based approach to learning evident in the preschools is something worthy of maintenance and enhancement.

### *Chronology of the SNI Preschool Project*

The authors of this paper worked with a small group (n=7) of preschool educators for two days in 2005 and two days during 2006 as part of the professional development component of the SNI Preschool Project. On the first day, background information was presented and discussed on the nature of powerful mathematical ideas and their relevance to early childhood education (Perry & Dockett, 2002). Participants agreed to use the powerful mathematical ideas presented in their planning and assessment of children's learning outcomes — part of the action research element of the SNI project. As well, participants were introduced to the learning stories (narrative assessment) (Carr, 2001; Carr & Claxton, 2002) and were invited to use this assessment approach in their settings. The second professional development day emphasised links between the Developmental Learning Outcomes from the *South Australian Curriculum, Standards and Accountability Framework (SACSA)* (Department of Education, Training and Employment, 2001) and the powerful mathematical ideas introduced on the first day. During the second day, participants were introduced to the notion of a numeracy matrix and provided with some exemplar cells in the matrix (see below for further details about the matrix). Part of their task on this day was to complete other cells in the matrix. The third professional development day was held in March, 2006 and allowed the early childhood educators to share their experiences with the numeracy matrix and with the learning stories assessment approach. A further meeting in June, 2006 continued the refinement of the matrix and the development of the educators' expertise in using it in their settings, particularly in terms of using it to analyse their learning stories. Between the four meetings, e-mail contact between the authors of this paper and the seven early childhood educators was maintained. There was similar contact among the early childhood educators themselves. Purposes for these contacts varied but included: clarification of the educators' understandings about the numeracy matrix; checking on the appropriateness of their planning and implementation initiatives; and celebration of their successes.

The SNI preschool project team was successful in presenting a seminar on their work at the annual *Innovation and Equity in Early Childhood* conference in Melbourne in November, 2006 and were invited to address the *Early Childhood Forum* for their districts in March, 2007. At this last meeting, over 180 preschool and school educators were able to hear and see the work of the seven early childhood educators in the project.

For the early childhood educators involved, the SNI project provided a sustained and supported professional development project focussed around the enhancement of children's mathematical learning. This paper investigates the nature and impact of this program.

## *The Numeracy Matrix*

The central product of the SNI preschool project is the *Numeracy Matrix*. This is a large table (56 cells) with seven powerful mathematical ideas (Perry & Dockett, 2002) on one axis and eight Developmental Learning Outcomes (DLOs) (Department of Education, Training and Employment, 2001) on the other. (The DLOs form the accountability framework for South Australian preschool educators.) The powerful mathematical ideas and the DLOs are brought together through 'pedagogical inquiry questions' — questions asked of early childhood educators about the practices they use to stimulate, observe and assess their children's mathematical learning. This use of pedagogical inquiry questions rather than student outcome statements arises from the belief that the key determinants of children's successful outcomes are the pedagogical relationships and practices of educators (Laevers & Heylen, 2004). An example of one cell in the numeracy matrix is given in Table 1.

Table 1  
*Numeracy Matrix Cell*

<i>DLO: Children are intellectually inquisitive</i>	
Powerful mathematical idea:	What opportunities do we give children to put forward a mathematical argument and to justify it?
<i>Argumentation</i>	How do we assist children to gain confidence in their ability to explore, hypothesise and make appropriate choices in their mathematics?

In this cell are two pedagogical inquiry questions designed to challenge preschool educators to reflect on what they are doing to help children develop both the mathematical idea and the developmental learning outcome. The answers to these questions will affirm those educators who are working towards these goals, as well as suggest to them what other activities might be needed to help the children develop further. The questions are also designed to stimulate educators who have not considered their practices in these areas to investigate the relevance of current activities and practices or the need for new practices. The complete numeracy matrix and details of its development can be found in Perry, Dockett, and Harley (2007).

## *Learning Stories*

*Learning Stories* are qualitative snapshots, recorded as structured written narratives, often with accompanying photographs that document and communicate the context and complexity of children's learning (Carr, 2001). They include relationships, dispositions and an interpretation by someone who knows the child well. They are "structured observations in everyday or 'authentic' settings, designed to provide a cumulative series of snapshots" (Carr & Claxton, 2002, p. 22).

In South Australia, learning stories have been used by preschool educators for some time. However, they tended not to be used in the area of mathematics, partly because the preschool educators did not have sufficient confidence in their ability to link what they were observing with mathematical learning outcomes. The introduction of the *Numeracy Matrix* has given this confidence to the group of educators working with the authors and has produced some outstanding results (see Harley, Perry, & Dockett, in press, for examples).

## Methodology

### *Participants and Contexts*

The participants in both the professional development program conducted as part of the SNI preschool project and its evaluation were three groups of preschool educators (total  $n=7$ ), in three different preschools in the southern suburbs and outskirts of Adelaide, South Australia. In each case the preschool director and one or two of the settings' teachers were involved in the project. All but one of the participants had 10 years or more experience as trained early childhood educators. The one exception was in her second year as an early childhood educator.

The three settings in which these seven educators worked were quite different from each other. Setting 1 is a small semi-rural centre in the hills to the south of Adelaide; Setting 2 is a centre in which up to 40 children per session from working class families in the southern suburbs of Adelaide are enrolled. Setting 3 is a large centre (up to 90 per session) servicing a mainly middle-class suburb approximately 30 km from the centre of Adelaide.

### *Data Generation*

Data for the evaluation of the professional development approach reported in this paper were gathered from the seven participants through self-reporting of their experiences and activities within the project, and their feelings about each of these. These reports were made as part of the 2-year SNI professional development program. Three forms of data generation were used.

- Anecdotal commentaries — from participants at the professional development sessions or as part of continued e-mail communication among the participants — about how the project was being implemented in their centres. These data were mainly descriptive but constant comparison analysis of the commentaries reinforced the themes established from the literature.
- A researcher-designed survey was completed by all participants at the end of the 2006 education year. This survey consisted of both multiple-choice closed questions and open-ended questions in which participants could (and did) express opinions, offer examples and further explain their responses to the closed questions.
- The seven preschool educators were involved in two public



presentations — one at an international early childhood conference and one to their peers in their education districts, including early childhood, primary and secondary teachers. Useful data for this project were gathered from these presentations in the form of the educators' reflections on children's learning and their own professional development.

In this paper, all of these data sources are used to develop a comprehensive, multi-faceted picture of the impact of the SNI preschool project on the seven participants.

## Results

### *Preschool Educators' Commentaries on Their Work in the Project: Professional Development Sessions and Presentations*

#### *Setting 1: Small semi-rural centre*

As part of their work on the development of children's voice in the planning and implementation of learning activities and practices, the two educators at this setting determined that they would concentrate on the pedagogical inquiry question: *What (children's voice) opportunities do we provide to enable children to reflect upon and communicate their mathematical thinking?* During 2006, the project participants received regular updates from the staff at Setting 1 on progress on this implementation. Some examples of activities undertaken are given in Harley et al. (in press). In their presentation to the Melbourne conference, the educators from Setting 1 listed the following as important learning for their children and for themselves:

- relationships build on trust and confidence;
- there is more than one answer or solution in working on a problem;
- practice and trying will reinforce learning and thinking in different ways;
- peer interactions are important in learning;
- time needs to be allowed for asking questions;
- a variety of questions from basic to the higher level promote learning; and
- there need to be opportunities for both children and educators for deeper thinking and scaffolding around the ideas of numeracy.

In their own reflections on what have been the key mathematical learnings for them, the following comments were made by the educators in Setting 1:

- The learning stories provide rich assessment of the children's learning. They have changed over time becoming more in depth and releasing the numeracy within.

- We have enriched our knowledge of the children with discussions with parents through our Governing Council, shared celebrations of literacy and numeracy as well as individual discussions with parents and networks.
- Our teaching has been enriched by the discussions and sharing of new stories within our learning circles.
- This has encouraged us to question what the children know and what they are capable of working out given time, opportunity and their own expression.

*Setting 2: Medium sized centre, working class families*

At this preschool, investigation and problem solving were often undertaken but, according to the educators themselves, without a lot of planning and little assessment. Hence, it was natural for the educators in this setting to choose the pedagogical inquiry question: *What opportunities do we provide for children to participate actively in collaborative mathematical problem solving and problem posing?* for their initial foray into using the numeracy matrix.

In one activity reported from this setting, the children were involved in a walk in the park during which they were invited to collect some of the autumn leaves that had fallen from the trees. Before they went for their walk, the educators offered a selection of baskets into which the children could place the leaves that were collected. However, this was not just any collection of baskets — there were differences in size and shape as well as design. Children chose their baskets and found that their choice often helped determine the types and sizes of leaves that they could collect. When they returned to the centre, the children were involved in activities such as sorting, counting and comparing the leaves but they now did this from a base in which they had already used the baskets that they had chosen as a classification system.

The two educators from Setting 2 reflected on their individual involvement in the SNI preschool project through the open-ended questions in the surveys they completed:

- I think that if we had not chosen an inquiry question, we may not have discovered such powerful learning in preschool children.
- Using the matrix and being able to develop one inquiry question and explore it in depth has illustrated to me how and when to assess children in a variety of ways.
- My ability to focus on mathematical learning and extend individual children's learning as well as assess it positively in learning stories is quite empowering.
- I have been energised, enthused and inspired by being part of the SNI project. I am now eager to incorporate any/all mathematical teaching into everyday practice.

*Setting 3: Large centre, middle class families*

In this setting, the three early childhood educators involved in SNI decided

that they would work with two pedagogical inquiry questions: *How do we provide opportunities for children to experiment and think about number in different contexts, including their own family group, traditions and rituals?* and *What opportunities do we provide for children to explore different mathematical ideas through collaborative group work?* One of the activities that the educators involved their children in to answer these questions was the design, construction and use of a puppet theatre. The children had seen a puppet theatre on an excursion to the local library and wanted to make one of their own. Using their knowledge of measurement and scale, they designed the theatre, drew plans and assisted parents in the construction.

The educators at Setting 3 reflected that they received the following benefits from SNI:

- deepening of our own mathematical understandings;
- ability to recognise the mathematical learnings the children demonstrated through play;
- realisation that all areas of mathematics were integrated, not just a focus on number;
- allowing children and educators to take risks;
- recognising different perspectives on tackling the same 'mathematical' task;
- knowledge and confidence in numeracy (e.g. writing a learning story and pulling out the various numeracy content and process strands reaffirmed that what we are doing supports numeracy development);
- partnerships with parents; and
- affirmation that mathematics is happening in our program, we just need to recognise it.

### *Survey Responses*

Each of the seven participants was asked, at the end of the 2006 education year, to complete a survey about their experiences in the project. The survey asked them to reflect on their participation in the project and ways in which they and their practice had changed as a result of this participation. Five pairs of questions asked them to track changes in their knowledge about key aspects of the project. All of these questions afforded a 5-point scale on which to respond along with an open comment if the respondents wished to make further explanatory notes. A further question sought information about how important — from 'Critical' to 'Useless' — various aspects of the SNI Preschool Project had been in the educators' professional development. The survey concluded with three open-ended questions summarising their involvement in SNI and its effects on their work with children.

Questions 1 and 2 regarding change in attitude were answered on a 5-point scale ranging from Very positive to Very negative while the other change questions used a 5-point scale from Very strong to Very weak. The results are summarised in Tables 2 to 6.

Table 2

*How Would You Describe Your Attitude to Mathematics Education for Preschool Children Before You Commenced the SNI Preschool Project/Now? (n=7)*

	Very positive	Somewhat positive	Neutral	Somewhat negative	Very negative
Before involvement in SNI		4	1	2	
After involvement with SNI	6	1			

Table 3

*How Would You Describe Your Knowledge about Mathematics Education for Preschool Children before You Commenced the SNI Preschool Project/Now? (n=7)*

	Very strong	Strong	Adequate	Weak	Very weak
Before involvement in SNI			4	2	1
After involvement with SNI	3	3	1		

Table 4

*How Would You Describe Your Knowledge about what Powerful Mathematical Ideas Might Be Developed by Preschool Children before You Commenced the SNI Preschool Project/Now? (n=7)*

	Very strong	Strong	Adequate	Weak	Very weak
Before involvement in SNI			4	2	1
After involvement with SNI	3	3	1		

Table 5

*How Would You Describe Your Knowledge about the Assessment of Preschool Children's Mathematics Learning before You Commenced the SNI Preschool Project/Now? (n=7)*

	Very strong	Strong	Adequate	Weak	Very weak
Before involvement in SNI			4	2	1
After involvement with SNI	1	5	1		

Table 6

*How Would You Describe Your Knowledge about the Developmental Learning Outcomes of the SACSA Framework before You Commenced the SNI Preschool Project/Now? (n=7)*

	Very strong	Strong	Adequate	Weak	Very weak
Before involvement in SNI		2	4	1	
After involvement with SNI	1	5	1		

All participants reported feeling more positive about themselves and mathematics in their settings and about gaining substantial knowledge, competence and confidence from their involvement in the project. Two comments from the surveys illustrate this growth.

Participation in SNI has provided a wealth of professional development opportunities which encouraged me to look at many play-based learning experiences in a different light. The initiative has encouraged me to look much more deeply at the holistic experiences we develop with children from a mathematical perspective, to unpack the mathematical learning that children have demonstrated and the learning they could expand with adult and peer support.

My ability to focus on mathematical learning and extend individual children's learning, as well as assess it positively in learning stories, is quite empowering.

In the final structured question on the survey, participants were asked to indicate on a five-point scale how important certain aspects of the SNI Preschool Project had been in the development of their knowledge and attitudes about mathematical learning. Table 7 records the results from this question.

Table 7

*How Important Are Aspects of the SNI Preschool Project to Educators' Professional Development? (n=7)*

	Critical	Important	Neutral	Not important	Useless
Powerful mathematical ideas	3	4			
Developmental learning outcomes	1	6			
Pedagogical inquiry questions	6	1			
Numeracy matrix	6	1			
Learning stories	6	1			
Team work	7				
Presentation at the Melbourne conference	5	2			

While the numbers in Table 7 clearly show the relevance to the preschool educators of the components of the project, their comments made in the open-ended sections of the survey reinforce this. For example,

The opportunity to work ... with the staff from [the other two centres] was insightful, stimulating and fun — just what we want learning to be.

We had the knowledge, the powerful ideas, a way of representing those ideas and the [pedagogical inquiry] question is a way of bringing it all together, as we

delve deeply into what it means, what we observe with the children, what our role is in the process and finally how we represent it.

The numeracy matrix allowed me to identify and extend mathematical learnings occurring in children's everyday experiences.

Learning stories are a really powerful way of collecting, sharing, presenting and reflecting upon children's mathematical learning. I've enjoyed the opportunity to experiment and develop different ways of creating learning stories.

The opportunity to present in Melbourne really consolidated my learning through the preparation process and reflecting upon my own mathematical learning journey. It gave me the skills to articulate the knowledge I had gained to others and celebrate our achievements.

### *Analysis and Discussion of Results*

Clearly, the SNI Preschool Project has had a very positive impact on its participants. The results in Tables 2-6 show substantial change in the participants' (self-reported) beliefs about, attitude to, and knowledge of, mathematics education in their preschool settings. The results displayed in Table 7 further reinforce the importance of the key components of the project. In particular, the critical importance afforded pedagogical inquiry questions, numeracy matrix and learning stories suggests that these innovative approaches to the learning, teaching and assessment of mathematics in preschools have proven of value to the educators involved. The approach is openly one of meaningful learning and assessment for learning. The functionality of learning stories for the presentation of children's learning and for future planning is seen by the participants as a major strength of the approach introduced through the project.

The two aspects of teamwork and the Melbourne conference presentation are also rated very highly by the participants. The development of the team of seven early childhood educators was gradual over the duration of the project and was built upon the mutual support provided by all team members both at the professional development sessions and between them. The team members built up relationships that were nurtured through electronic communication as well as face-to-face contact. While the entire team built its partnership strengths, at each preschool the project provided a focus for the strengthening of the local team of educators. The sustained (and supported) nature of the project's professional development approach has been appreciated by the participants.

The SNI Preschool Project began amidst concerns from the preschool educators that their programs and their children's learning of mathematics were in danger of being compromised by state and local approaches to accountability. The project has produced a comprehensive and innovative solution to these concerns which not only allows preschool educators to be accountable against the mandated Developmental Learning Outcomes but which has inspired a small group of early childhood educators to continue to improve their practice in mathematics education and to share their skills and knowledge with their peers.

In the interpretation of the results from all of the data sources available, we

need to remember that the educators are reporting on their experiences in the project to the developers of the project. Hence, it could be seen that the educators were simply telling the authors what they thought we wanted to hear. Two aspects of the project stand counter to this observation. Firstly, there are three different forms of educator-generated data that have provided consistent reporting of success. Secondly, over the period of 3 years for which this project ran, the authors and the educators developed a great deal of trust and respect for each other. Not everyone agreed with every idea or action put forward and there was an atmosphere in the group that these differences could be expressed without fear or favour. In spite of this opportunity, the educators consistently reported favourably on all aspects of the project.

## Conclusion

The SNI Preschool Project is a small professional development project that has had an important impact on the participants. It has brought together the key notions of powerful mathematics ideas, Developmental Learning Outcomes, pedagogical inquiry questions and narrative assessment to provide a holistic approach to the mathematics education of young children. It has empowered seven early childhood educators to try things that they would not have tried, to take risks and be supported in their practice. The numeracy matrix coupled to learning stories has reinforced and legitimised successful early childhood practice at a time when it is under serious threat from the 'pushing down' of curriculum and pedagogy from education systems focussed on accountability regimes in their narrowest sense (Scott-Little, Kagan, & Clifford, 2003). As the Position Paper on Early Childhood Mathematics (AAMT/ECA, 2006) suggests, early childhood educators need to

adopt pedagogical practices that encourage young children to see themselves as mathematicians by stimulating their interest and ability in problem solving and investigation through relevant, challenging, sustained and supported activities. (p. 2)

and they should

assess young children's mathematical development through means such as observations, learning stories, discussions, etc that are sensitive to the general development of the children, their mathematical development, their cultural and linguistic backgrounds, and the nature of mathematics as an investigative, problem solving and sustained endeavour. (p. 3)

The SNI Preschool Project has addressed both of these issues successfully through a sustained and supported process of professional development. Comments from the participants such as the following provide warrant to this claim.

This initiative has confirmed and expanded my understanding of the significant mathematical learning that children demonstrate and explore in so many different everyday experiences. It has encouraged me to question more deeply,

provide resources in ways that encourage children to expand their understandings and support children to develop their own strategies for solving problems.

The project has allowed me to reflect critically on my practice. Previously maths learning was short term, perhaps disjointed, events. Now, I've learned that a long term interest or project can contain many aspects of maths learning.

There are many elements that have contributed to the success of our learning journey — funding to allow us to participate in professional development, interaction with colleagues (academic, curriculum officer, practitioner), time (this initiative has given us the time to explore our practice in an unrushed manner without pressure for a 'quick fix' solution, we have had time to build relationships of trust and hence the confidence to be open and honest about our learning) and finally accountability (in the form of a professional presentation).

While there may be some general confusion over the role of preschools in young children's lives and in society (McCain et al., 2007; Scott-Little, Kagan, & Clifford, 2003), the participants of the SNI Preschool Project have declared that they are interested in stimulating the mathematical learning of the children in their settings in ways that allow them to maintain the integrity of their early childhood practices. The numeracy matrix has encouraged them to engage with their children in pedagogical interactions (Siraj-Blatchford & Sylva, 2004) designed to encourage learners to learn through cognitive challenge in a supportive environment.

While the current round of the SNI Preschool Project has been completed, none of the participants is willing to let go of the ideas and practices it has nurtured. All are determined that the experiences shared over the last two years should be made available to other preschool and first years of school teachers. To this end, the project team has moved to dissemination strategies such as publication and presentation so that the messages about the importance of the processes involved and the achievements made can be shared. Strategies are being developed to 'scale-up' the project to all 350 government preschool sites in South Australia as well as to schools who are willing to commit to an extended period of supported professional development in a critical area of children's learning. The SNI Preschool Project is a strong beginning that has shown what is possible. We continue to build on this beginning.

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