SUPPORTING YOUNG CHILDREN'S MATHEMATICS LEARNING AS THEY TRANSITION TO SCHOOL

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It is now acknowledged that children start school with a wealth of mathematical knowledge and experiences (e.g. Aubrey, 1993; Perry & Dockett, 2004; Young-Loveridge, 1989), and that recognition of this rich resource by the new entrant teacher may facilitate the smooth transition of the child into school (Perry & Dockett, 2004). Positive transitions directly impact on children. This paper investigates how the mathematics content, understanding and practices of the new entrant classroom align with the learning children experience within early childhood settings. In particular it reports on the supportive practices provided by two schools for young children's mathematical learning as they begin school. Results from the study show tenuous links in mathematical practices between these sectors.

Background

As a direct result of recent research interest in areas of early mathematical learning there has been a surge of interest in the development of mathematics in early childhood. Researchers now recognise the 'mathematical power' young children possess on entry to formal schooling (Clements & Sarama, 2007; Perry and Dockett, 2005). Furthermore, understanding that the child's competence in mathematics at the end of the first year of schooling is a strong predictor of later success in mathematics has contributed to a focus on early mathematics. We questioned how schools support young children's mathematical development and how that support connects with the support provided within the early childhood settings?

Transition from early childhood to school can pose difficulties for new entrant (NE) children (Eyers & Young-Loveridge, 2005; Perry & Dockett, 2004) and has a long-term impact on school achievement (Timperley, McNaughton, Howie, & Robinson, 2003). Kagan and Neuman (1998) suggest there are high costs when there is a lack of continuity between sectors; this results in lower success rate at school, difficulties in making friends and vulnerability to adjustment problems. It has been argued that for successful transition the differences and discontinuities between the sectors need to be addressed, as "starting school is not a simple process" (Margetts, 2007, p. 106).

Transition to school calls for the development of "higher mental functions" (Broström, 2007, p. 61) if a successful move from a play focus to a more formal school learning system is to be achieved. Furthermore, it is suggested that the differences between the requirements of early childhood and school settings may invite problems

related to adjustment (Kienig, 2002). Broström (2002) has noted that these requirements are a consequence of different social and academic goals between the school and those of the pre-school setting. Tensions arise as a result of change from a learning environment based on socio-cultural and co-constructivist ideas of learning (Bronfenbrenner, 1979) to more structured activities and formal instruction (Pratt, 1985), and in which there are very different expectations by teachers within early childhood education (ECE) and the primary school sector (Timperley et al., 2003).

Arguably, barriers to smooth transitions vary depending on the individual contexts, and in particular on relationships that have developed among ECE services, schools and parent/caregivers. Successful transition to the school setting has been described as an ecological transition between two "microsystems" (Bronfenbrenner, 1979). A comprehensive framework for understanding the complexity of child development has been provided by Bronfenbrenner (Margetts, 2007) and adapted as a "Levels of Learning" framework by the New Zealand early childhood curriculum *Te Whāriki* (Ministry of Education, 1996. p. 19). Here the learner and his or her engagement within their immediate environment (or microsystem) are situated as the first level of learning (Peters, 2003). The second level (or mesosystem) extends to the relationships between the immediate learning environments. In the context of early childhood this relates to the home and family, the early childhood setting and the people within these contexts. Level three (exosystem) encompasses the influence of the adult's environment on their capacity to care and educate. Wider social beliefs about the value of early childcare and education form the final level (macrosystem). *Te Whāriki* is mainly concerned with these first two levels whilst acknowledging the influences of the other two. In Margetts' (2007) view it is this combination of the child's personal characteristics, their experiences, and the interconnections between home, prior to school settings and school that ultimately determines how the child adjusts to school.

At the early childhood level teaching involves "reciprocal and responsive interaction with others", building on the "child's current needs, strengths, and interests by allowing children choices and by encouraging them to take responsibility for their learning" (Ministry of Education, 1996, p. 20). The child is viewed as a competent learner and communicator and 'dispositions to learning' is included as an important outcome. "Dispositions are a very different kind of learning from skills and knowledge. They can be thought of as habits of the mind, tendencies to respond to situations in certain ways" (Katz, 1988, p. 30). The child's dispositions towards learning are reflected in the nature of assessment undertaken in early childhood settings. Narratives of incidences of a child's/children's learning are often in the form of a 'learning story' (Carr, 2001); they focus on dispositions such as curiosity, trust, perseverance, confidence and responsibility rather than specific content areas and achievement objectives.

A strong influence on mathematics teaching and learning in New Zealand schools is the Numeracy Development Project (Ministry of Education, 2001). A key focus of the project is on developing teacher's pedagogical knowledge and mathematics content knowledge, and improving the performance of all students. The Number Framework (Ministry of Education, 2001) provides a framework for the development of number knowledge and mental strategies. Professional development for teachers promote effective mathematics pedagogy together with the provision of teaching booklets, activities and resources, and on-going professional support.

The latest curriculum reform for schools, *The New Zealand Curriculum* (Ministry of Education, 2007) acknowledges and celebrates the development of dispositions in the form of 'key competencies' (p. 12) that "young people need for growing, working, and participating in their communities and society" (p. 38). An underlying theme within this curriculum is a stronger cohesion between the two sectors through a focus on key competencies (Young-Loveridge & Peters, 2005). Although in its infancy, the implementation of this document heralds within a 'formal curriculum' a focus on children's competencies in developing capabilities for living and life-long learning. Competencies are viewed as "not separate or stand alone" and are "the key to learning in every learning area" (Ministry of Education, 2007, p. 12). The alignment of dispositions and key competencies may also develop a continuity of the learning environments across the sectors (Carr, 2006). The ways in which the practices of the new entrant classrooms align with the practices of the ECE services is the focus of this paper.

Methodology

The research was a two year study which investigated the existing transition practices, in a small town in New Zealand, between four early childhood education (ECE) services and two primary schools with regard to mathematics learning and teaching. The research was centred on one key question: What ECE and new entrant practices facilitate positive transitions in mathematics between early childhood settings and primary schools? A case study approach allowed the researchers to focus on interactions between specific instances or situations and to study in depth the transition practices in mathematics within focussed time frames. Evidence was systematically collected enabling the relationships between variables to be studied over time. Our data collection method involved observations in both sectors, teacher interviews, documentation including a range of artefacts, teacher planning, policies relevant to teaching programmes and transition, copies of newsletters, copies of assessments, and photographs of children involved in mathematical experiences. All documentation was analysed and categorised by major themes related to transition and teacher practice using the theoretical framework of Bronfenbrenner's (1979) analogy of the child's learning environment as 'interconnected systems'. In the study the five key themes analysed within this framework were: structural provisions for mathematics, the assessments that are made with regard to children's mathematical understanding, how information is conveyed between sectors, process and provisions for transition, and parental perceptions and expectations.

Findings from Phase 1 explored practice in four ECE services and findings (see Davies & Walker, 2008) provided a baseline of practices for comparison with the school sector. We were interested in investigating how "this new stage in children's learning builds upon and makes connections with early childhood learning and experiences" (Ministry of Education, 2007, p. 41) This paper reports on the second phase where transition practices were investigated to determine the extent to which "schools can design their curriculum so that students find the transitions positive and have a clear sense of continuity and direction" (Ministry of Education, 2007, p. 41).

The second year of the research was undertaken in two primary schools (Nikau and Punga) to which many of the children from the four ECE involved in Phase 1 had

transitioned. Both are large primary schools. School Nikau is a decile[1] 4 school with 480 pupils from new entrant (NE, or reception class) to Year 10, across 20 teaching classrooms. School Punga is a decile 3 school with 440 pupils enrolled, consisting of NE to Year 8, across 16 teaching classrooms. In New Zealand children can generally start school on the first school day after their fifth birthday, which results in a continual arrival of children in the NE classroom. School Nikau had two NE classes continually filling whereas School Punga had one NE class already full (25 children) from the beginning of year, and a second NE class filling. All four teachers and classes were involved in the research project.

This paper focuses on two key themes of the research: structural provisions for mathematics, and the assessments that are made with regard to children's mathematical understanding in school settings (for full report see Davies, 2009). The examples are chosen to illustrate the range of transition practices and are representative of findings within this case study. Results of this study are relevant to these project sites and may not be able to be generalised.

Results and discussion

Structural provisions

One key theme of the study was the differences and discontinuities in the structural provisions (i.e. the approach to teaching and learning, and use of resources) between the early childhood settings and the schools. The approach to learning in ECE is holistic in nature based on Bronfenbrenner's (1979) idea of the child engaging with the learning environment. Children are immersed in rich learning experiences across a range of subject curriculum areas with a strong focus on the child's interest often embedded in play. The approach to learning in a school setting may be viewed as a change in focus from personal, social and emotional development of the ECE to the formal beginning of specific subjects and content prescribed in the form of 'achievement objectives' from the national curriculum (Stephenson & Parsons, 2007). In Bronfenbrenner's framework the move is towards the second level of learning. The children were being affected by what happens outside their own 'microsystem'.

Lessons contrasted greatly from the children's socio-cultural experiences promoted in the early childhood settings. While teachers expressed a belief in the importance of learning through play, they did not reflect this in practice (Sherley, Clarke, & Higgins, 2008). Authentic social contexts for learning which the new entrant previously experienced were not provided through whole class learning and through the activities provided in the resource materials (Belcher, 2006). There was a strong belief in both schools that games or activities from the Numeracy Project replicated the children's earlier experience of learning through play.

> I suppose that helps them transition. I suppose we just expect them to start participating in the games (Nikau Teacher, 1).

[1] The decile rating of a school is based on a Government assessment of the school in terms of the nature of the school community, particularly regarding the predominant socio-economic make up of that community, with 10 being the highest.

> I think there is an expectation of when they come [pause] well how they behave when they are at school and numeracy time is a set time … So we cater to those children by doing games (Nikau Teacher, 2).

It has been demonstrated that children in classes where teachers have used more developmentally appropriate practices exhibit less stressed behaviours (Margetts, 2007). Stephenson and Parsons (2007) emphasise that play should continue to have an important part in developing children as learners in the first few years of schooling.

> Yes they are allowed to have free choice not so much in maths time because I do prefer them to use more appropriate activities that tie in with what they have been learning (Punga Teacher, 1).

Although it has been suggested that school teachers should be responsive and reflective to the diversity of backgrounds in the early weeks of schooling (Margetts, 2007), little evidence was found of this. Concerns have been raised that children become impassive and disempowered with more formal approaches to teaching which may lead to anxiety and low self-esteem (Stephenson & Parsons, 2007). It was commonplace, in all four classrooms visited, for children to be placed in ability groups from their first day at school. Formal whole class teaching followed by group rotations using a range of teacher selected independent activities was widespread. Children in the non-contact group, although having some control over their learning through their choice of resource, had little opportunity to interact with the teacher. Similar to the findings of Belcher (2006) the teacher was unable to scaffold or respond interactively to children's initiations because they were predominately engaged in instruction or classroom management.

> We have ability groups. We have two rotations. One rotation they see me and two they do an independent activity. That goes for four days a week and on the fifth day we have a maths circuit (Nikau Teacher, 2).

> They [non contact groups] will either be activities to reinforce previous learning or to help with current learning or a sheet [photo copied work sheet]. More formal type activity for counting. Something where they have got to record (Punga Teacher, 1).

However, one classroom teacher provided practical experiences and opportunities for structured play with opportunities for children to experience confidence and success and to maintain their perception of themselves as effective learners.

> Because I try to make an easy transition from pre-school to school. So you are not from day one sitting down and doing this, this, this. You've got to have free time and activities where the children can unwind and relax. Because they can't stay full on all day (Punga Teacher, 2).

> It is a bit of both really. That is where I have developmental type activities - so they have a little bit of structure on the mat. Then they have freedom of other activities at the same time they are learning that rotation process (Punga Teacher, 2).

Mathematics learning in primary classrooms was teacher initiated with predetermined learning intentions. The four teachers had similar fixed ideas as to the particular needs of new entrant children and planned and directed the children's learning according to their predetermined intentions. As in a study by Sherley, Clark, and Higgins (2008) teachers were in control of the learning environment providing activities to 'plug the gaps'.

> Well, we see were the gaps [in children's knowledge] are taken out of the numeracy project book and we just follow that (Nikau Teacher, 1).

> I just stick them in a bottom group for a start to see what they can do and normally you can recognise straight away if they can recognise numbers or count (Nikau Teacher, 2).

> I guess you are really quite restricted but you have your planning and guidelines for numeracy project so usually that really controls most of what you do (Punga Teacher, 1).

Our findings confirmed earlier views that the professional development project does not allow teachers to develop a comprehensive understanding of the pedagogy appropriate for transitioning children. Belcher (2006) suggested that the children's experiences in numeracy were largely influenced by the teacher's belief and understanding of the numeracy project. This may be attributed to a lack of confidence and knowledge of teachers on how to teach numeracy through play (Stephenson & Parsons, 2007).

Assessment

The second theme of the research in this report was the assessment made with regard to children's mathematical understanding in school settings. Narrative assessments were the most common form of documentation in all the ECE. These tended to document, in written and photographic form, the dispositions exhibited by the child rather than acknowledging the development of content knowledge. Very different assessment practices from those at ECE were undertaken at the school. Similar to a study by Sherley, Clark, and Higgins (2008) the teachers did not attend to the knowledge and skills the children already had on entry to school. All teachers had limited understanding of mathematics teaching and learning in ECE.

> A huge jump for children who didn't know anything when they started. I think early childhood provides for all the opportunities it is just that if the children don't choose to take those up then when those children then come to school with nothing and then you already have a gap (Nikau Teacher, 1).

> I think there is a lot of maths going on in all the different areas but very much depends upon the teacher being there at the moment to facilitate it. … I think they might do a lot of rote counting, that sort of thing. But when they come to us I see always a gap in number recognition and sometimes 1 to 1 counting (Nikau Teacher, 2).

New Entrant teachers indicated their use of either the 'I can …' checklists (Ministry of Education, 2005) or the 'Numeracy Project Assessment' tool [NumPA] (Ministry of Education, 2006) to assess children early in their schooling.

> We do observation assessment for the first six weeks and then in the sixth week we do the NumPA Form A … and after that we carry on with a tick chart, one from the numeracy project stage that they are at (Nikau Teacher, 1).

These checklists provide a guide for teachers with their planning. However they provide little attention to the situated nature of learning experienced by children prior to school. Concerns have been made regarding the use of such tools with its focus on narrowly defined goals and checklists (Peters, 2004) at a NE level. The resulting categories and classifications fail to recognise the richness of children's mathematics learning resulting from holistic experiences prior to starting school. The new entrant teachers referred to filling the gaps in children's knowledge and tended to overlook the competencies earlier documented within the ECE narratives.

> We get the same thing playing games and you get an idea of stage and what group children would fit into. I guess the NumPA just confirms … and also it finds the gaps that maybe you don't always find in games (Nikau Teacher, 2).

> So they come out at 0 [Stage 0 of Number framework] so they don't know any of the things (Nikau Teacher, 1).

Conclusion

The richness of mathematical learning experiences that children bring with them to school has been well researched (Aubrey, 1993; Perry & Dockett, 2004; Young-Loveridge, 1989). Perry and Dockett (2005) analysed the many mathematical experiences children have in prior-to-school settings demonstrating "immense knowledge … including mathematics" (p. 36) and the mathematical power of young children's skills in mathematising, making connections and argumentation. There was limited recognition of this mathematical power among NE teachers, and little attempt to nurture it by providing learning experiences that made connections to their existing mathematical understanding by the primary school teachers.

Involvement in the numeracy project dominated the teaching of mathematics in the new entrant classes. Children experienced structured numeracy lessons involving whole class mat-time followed by ability group rotations. The use of numeracy project activities and games varied between classes for non-teacher contact groups. Structured mathematics games were believed to replicate the learning approach of the ECE.

Narrative assessments in ECE were very holistic in nature focussing on dispositions to learning. On the other hand the Numeracy Project assessment tool and "I can …" checklists were the main methods of school assessment and these failed to assess the richness of children's previous mathematics learning. There was a failure to recognise the rich holistic experiences of children's mathematics learning prior to starting school. The new entrant teachers referred to the filling the gaps in children's knowledge and tended to overlook the competencies earlier documented within the ECE narratives.

It was evident that connections between the mathematical practices and experiences within early childhood setting and the new entrant classroom were tenuous. Little flexibility was shown in the extent to which the new entrant teachers were prepared to adapt teaching approaches for transitioning children. The NE teacher directed learning rather than being responsive to children's previous ECE experiences. Activities were structured with a specific learning focus. However, this limited the opportunity for children to engage in exploration and play. Assessment practices were narrow in focus and did not connect with the 'mathematical power' demonstrated by the children in ECE settings.

Further effort is needed in order that "this new stage [the transition from ECE to school] in children's learning [that] builds upon and makes connections with early childhood learning and experiences" (Ministry of Education, 2007, p. 41) becomes a reality. Findings from this study indicate that a reform of transition practices is needed to ensure that "schools can design their curriculum so that students find the transitions positive and have a clear sense of continuity and direction" (Ministry of Education, 2007, p. 41). Only when that occurs will children's mathematical experiences be optimised as they transition from early childhood to school.

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