

# Early childhood mathematics teaching: challenges, difficulties and priorities of teachers of young children in primary schools in Ireland

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Issues of pedagogy are critical in all aspects of early childhood education. Early childhood mathematics is no exception. There is now a great deal of guidance available to teachers in terms of high-quality early childhood mathematics teaching. Consequently, the characteristics of high-quality early childhood mathematics education are clearly identifiable. Issues such as building on young children's prior-to-school knowledge; engaging children in general mathematical processes; and assessing and documenting children's learning are some of the key aspects of high-quality early childhood mathematics education. The extent to which teachers of four- and five-year-old children in primary schools in Ireland incorporate current pedagogical guidance in early childhood mathematics education was explored in 2007 in a nationally representative questionnaire survey of teachers of four- and five-year-old children attending primary schools. This paper presents some of the findings of the study in relation to teachers' self-reported challenges, difficulties and priorities in teaching early childhood mathematics. Implications are drawn for professional development, curriculum guidance and educational policy.

**Keywords:** early childhood mathematics; pedagogical guidance; pedagogical challenges; pedagogical priorities

## Background

Literature from the early childhood field internationally defines a range of general pedagogical strategies that are considered particularly appropriate and effective in promoting young children's learning in early education settings (Bowman, Donovan, and Burns 2001; Siraj-Blatchford et al. 2002; Spodek and Saracho 2006). With regard to the development and learning of mathematics, and numeracy in particular, it is now generally accepted that certain experiences and practices are necessary to ensure that all children have access to appropriate, engaging and challenging mathematics (Clements, Sarama, and DiBiase 2004; Australian Association of Mathematics Teachers and Early Childhood Australia 2006).

However, we know very little about the challenges and difficulties that teachers face in developing young children's mathematical ideas, skills, understandings and attitudes (Ginsburg and Golbeck 2004; Ginsburg et al. 2005). The purpose of the research reported here was to gather information about Junior Infant (JI) teachers' opinions, beliefs and self-reported pedagogy as it relates to the teaching of mathematics in

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the first year of school in Ireland. This paper presents results of a national study, part of which investigated teachers' perceived challenges and difficulties in relation to teaching mathematics to four- and five-year-old children. Also presented are teachers' stated pedagogical priorities and goals for developing their mathematics teaching.

### **Early childhood mathematics in primary schools in Ireland**

In the Irish context, the mathematics education of children (aged 4–12 years) in primary schools is delineated in *Primary school curriculum: Mathematics* (Government of Ireland 1999a). This is a detailed statement of content in the form of skills and concepts to be acquired, and learning objectives to be achieved. In common with the curriculum statements of many other countries the learning intentions for young children at school are organised around the usual strands that include Number, Shape and Space, Data, Algebra and Measure and detailed learning objectives are listed for each of these. *Primary school curriculum: Mathematics. Teacher guidelines* (Government of Ireland 1999b) accompanies the curriculum statement and is described as '...an aid and resource for teachers and schools as they encounter the curriculum and begin to implement its recommendations' (66). The guidelines seek to explore a wide range of approaches and methodologies that develop the new emphases and give expression to new thinking on teaching and learning. They also explicate the content of the curriculum. In addition, the guidelines include what are described as detailed exemplars and sample lessons that demonstrate the newer approaches. In *Primary school curriculum: Introduction* (Government of Ireland 1999c), it is claimed that the curriculum incorporates current educational thinking and the most innovative and effective pedagogical practice. It was heralded as a curriculum that set out clearly not only *what* the child should learn but *how* the child should learn most effectively (National Council for Curriculum and Assessment (NCCA) 2000). For instance, the curriculum emphasises the importance of the children's own experiences as key reference points in learning mathematics. It advocates that children be encouraged to use a range of forms of recording mathematical activity including, as and when appropriate, the traditional written algorithms. The key role of discussion is emphasised and the necessity for children to work with materials individually and in small groups is outlined.

### **Ideas about pedagogy arising from socio-cultural theory**

Theorists in the field of early childhood education are encouraging and urging early childhood educators in general towards a socio-cultural approach in their practices (Bruner 1996; Rogoff 1998; Carr 2001; Fler and Richardson 2004; Anning, Cullen and Fler 2004). This approach conceives of effective practice as that which is built on the construct of the learner as active, and as an equal partner in any transaction. In a socio-cultural approach the learner is foregrounded and adult and child learners are seen as situated in particular social, cultural and historical contexts. Learning is constrained or limited by the beliefs, artefacts and practices of the particular context in which learning is taking place. It is marked by a pro-active pedagogical approach in which the teacher promotes learning through active engagement with the learner and knowledge is understood to be co-constructed between learners. The relationships that mediate learning are seen as an important focus for evaluation of quality, and collaboration between the child and peers is valued as well as that which occurs between child and adults. Thus, the role of the teacher is seen as central since it is the

teacher who enables the learning to take place by pro-actively engaging with the learner, the curriculum and the learning context.

### **General recommendations on pedagogy in early years mathematics**

It has been observed that we know almost nothing about the early teaching of mathematics and science (Ginsberg and Golbeck 2004). Gifford (2004) provides one possible explanation with her analysis that early childhood mathematics research has focused extensively on children's competence, but not on pedagogy. The Committee on Early Childhood Pedagogy for the United States Research Council described pedagogy as referring broadly to '...the deliberate process of cultivating development' (Bowman, Donovan, and Burns 2001, 182). From the committee's perspective, pedagogy has three basic components; curriculum, or the content of what is taught; methodology, or the way in which the teaching is done; and techniques for socialising children in the repertoire of cognitive and affective skills required for successful functioning in society that education is designed to promote.

Bowman, Donovan and Burns' (2001) analysis is that an early childhood pedagogy coherent with socio-cultural views of learning is one that it is not ultimately about free play, instruction or placing the child in a carefully chosen stimulating environment, but the critical factor is a high degree of direct adult engagement and guidance in the process of construction of learning.

Also, sensitivity to individual children's current competence is recognised as a key factor in pedagogy in early childhood (Drummond 1993; Wood 1998; Anning and Ring 2004; Clements, Sarama, and DiBiase 2004). Building on this implication of an interactive pedagogy, Ginsburg et al. (2005, 176) characterise the adult's role in early childhood mathematics education for three-, four- and five-year old children as one of providing what they term 'strong adult guidance'. However, they also caution that this involves more than free play or a push-down curriculum, i.e., 'a curriculum originally designed for older children' (2005, 175) and they are clear that what is required is that teachers change the way they teach to ensure that the pedagogy used is appropriate for this age-group. Their vision for early childhood mathematics education involves three elements; the guidance of the adult, the introduction of challenging mathematics and the development of children's natural interest in mathematics. They suggest that one of the fundamental requirements for early childhood teachers must be the ability to develop appropriate pedagogy for young children. Similarly, in England, the authors of a major longitudinal study of effective pedagogy in early childhood (Siraj-Blatchford et al. 2002) suggest that, in general terms, specifying pedagogy for the early childhood field may be more important than specifying curriculum.

### **Importance of teachers' skills and knowledge**

Undoubtedly the question of teacher knowledge and understanding is an issue in considering teachers' early mathematics pedagogy. Aubrey's (1995) analysis of patterns of mathematically related interactions between reception-aged children and their teachers revealed that more knowledge supports dynamic interactive discussion during teaching and learning. Her analysis further revealed that where such knowledge was limited teachers placed a greater emphasis on facts, relied more on workbooks and worksheets, and placed greater emphasis on individual work by children. In terms

of differences in styles of teaching, Aubrey's findings suggested the importance of a supportive style of interactive pedagogy that both assesses and extends children's mathematical learning.

Aubrey (2003) described the demands, in terms of pedagogy, on teachers of the Foundation Stage Curriculum in England (then understood to mean the play-based curriculum for three- to five-year-old children) and she characterised the challenges to teachers in respect of an early mathematics pedagogy that builds on children's informal knowledge as follows:

[it] lies in knowing how to plan and structure the curriculum to take account of and extend this rich knowledge by close attention to the balance of whole-class, group and individual teaching, as well as child-initiated, adult-directed or adult-supported activity... a wide range of teaching strategies will be required to motivate, support and extend appropriately. (Aubrey 2003, 50)

Recently, in some countries, there have been substantial efforts to guide early childhood teachers in relation to pedagogy. For instance, the Australian Association of Mathematics Teachers and Early Childhood Australia have recently issued a joint statement regarding pedagogic recommendations to early childhood educators in respect of mathematics teaching (Australian Association of Mathematics Teachers and Early Childhood Australia 2006). This joint position paper specifies 16 recommendations which deal with the range of aspects of pedagogy including interactions and communication, planning, resources, assessment, building on children's experiences, key learning and the role of language.

In the USA, in recognition of the need for pedagogical guidance for early childhood mathematics teaching, a range of experts including mathematicians, mathematics educators, researchers, curriculum developers, teachers and policy makers came together to agree the Standards for Early Childhood Mathematics Education (Clements, Sarama, and DiBiase 2004). Seventeen research-based standards were developed, eight of which pertain directly to pedagogy. In essence, these recommendations present a vision for practice in relation to teaching mathematics to children in the age range 2–8 years. Specifically, these eight focus on the following key issues:

- The importance of teaching and learning mathematical processes as well as content (Recommendation 4)
- The range and type of learning experiences (Recommendations 6 and 7)
- Teaching techniques and strategies (Recommendation 8)
- The role of various types of technology (Recommendation 9)
- The child's perspective (Recommendation 10)
- The development of conceptual knowledge alongside the development of skills (Recommendation 11)
- Appropriate integrated and formative assessment (Recommendation 12)

### **Importance of teachers' attitudes and beliefs**

Researching teachers' thinking is a relatively new area of research. Einarsdottir (2003) discusses how such research has shown that teachers' thinking plays an important part in teaching, and that teachers' theories and beliefs influence their pedagogy. Bennett, Wood and Rogers (1997) have observed how research endeavour in the area of teachers' thinking was somewhat bedevilled, initially, by confusion regarding the

extent to which various terms used could be considered to be related, analogous, synonymous or encapsulating. The terms disputed include those such as attitudes, beliefs, views or theories. Einarsdottir (2003) also refers to the fact that various concepts are used in defining teachers' beliefs with researchers referring to, for example, thoughts, values and implicit theories. She suggests that a broad definition of beliefs is that of 'tacit, often unconsciously held attitudes teachers have about schooling, teaching, learning, students, classrooms, and the academic material to be taught' (Einarsdottir 2003, 115–6). For the purposes of this article I am equating the terms *attitude* and *belief*. In this study, the term attitude was the term used in the teacher-questionnaire since I felt that this term most clearly related to teachers my area of interest.

In the USA, a recent study which focused on the relationship between the beliefs and intentions of 71 early childhood teachers indicated that beliefs were predictive of intentions (Wilcox-Herzog and Ward 2004). In England, Bennett, Wood and Rogers (1997) researched pedagogy in relation to play and their study indicated the importance of context when considering teachers' attitudes to pedagogy. In her review of research on teachers' beliefs, Einarsdottir (2003) concluded that the social context was important and that beliefs held by other teachers in a school and the school climate surrounding teachers all affect teachers' beliefs and practices. Her review indicated inconsistencies in the findings of studies that focused on the congruence between teacher beliefs and their practices. Some studies indicated coherence between beliefs and practices while others indicated inconsistencies. Einarsdottir's review also concluded that early childhood teachers who do not practice according to their stated beliefs are mainly those who work with more academic-oriented curricula.

Recently, pre-kindergarten teachers' beliefs regarding the question of appropriate mathematics education for four-year-old children were explored in the USA (Lee and Ginsburg 2007). The 30 teachers in the study shared a number of beliefs. For instance, they believed that current educational demands for the early mastery of mathematics necessitated explicit attention to specific ideas and concepts. Specifically, teachers mentioned one-to-one correspondence, counting, simple addition and subtraction, and writing numerals. They also believed that while a certain amount of direct instruction was necessary it should be done in small groups, in a fun and playful manner with engaging materials. Teachers' believed that it was important to capitalise on children's natural interest in mathematics but also to recognise the children's different abilities, aptitudes and interests. Furthermore, the teachers felt that mathematics teaching should not provoke stress or anxiety in children and that the development of affect was important. However, there were also clear differences among the teachers on a number of dimensions underlying their beliefs about early mathematics education, depending on whether they were working with low-socioeconomic status (SES) children at publicly funded pre-kindergartens or with children attending middle-SES pre-kindergartens. For instance, they differed on the dimensions of whether or not they placed a strong focus on mathematics education; on whether or not they focused firmly on the teachers' goals and plans; on the extent to which they endorsed mathematics education based on children and their interests; and on their endorsement of direct instruction for mathematics teaching. The low-SES teachers tended towards formality in approaches on all of these counts. The authors speculated that a combination of teaching experience, ethnic background and differences in educational levels all contribute to differences in teachers' beliefs about early childhood mathematics pedagogy.

## **Challenges and difficulties facing early years mathematics teachers**

It has been observed that it takes more than recommendations and curriculum statements to change practice in early childhood education (Siraj-Blatchford 1998). Early mathematics pedagogy is likely to be mediated by other factors related to, for example, context, teacher knowledge and adult-child ratios.

The research on which this paper is based sought to investigate the extent to which mathematics pedagogy in JI classes was coherent with current international recommendations as reviewed previously. The findings reported here focus specifically on identifying aspects of early mathematical pedagogy that teachers find particularly difficult and challenging. Asking teachers to state the aspects of mathematics pedagogy that they would most like to develop further illuminated their difficulties and challenges.

## **Key research questions**

Arising from the review in the previous section the following research questions are stated:

- (1) What are teachers' perceived challenges and difficulties in relation to teaching mathematics to four- and five-year-old children?
- (2) What aspects of their mathematics pedagogy would JI teachers most like to develop?

## **Design of the study**

### ***Method***

In Spring 2007 a national sample of 346 schools (c. 460 JI teachers) were surveyed using a questionnaire. The sample was derived as a result of examining the list of 3289 primary schools taken from the Department of Education and Science Website (<http://www.education.ie/home/home.jsp?pcategory=27173&ecategory=27173&language=EN>). Since the population of interest was teachers of children in their first year of school the list was refined to 3013 schools likely to have JI children enrolled. All schools with 19 or fewer pupils in total were also removed on the grounds that it was unlikely that there were any more than just a few JI children and consequently unlikely that the teacher was using a very specific and differentiated pedagogy with these children. At this stage there were 3013 schools on the list. A systematic random sample of 377 schools (sampling interval of 8) was generated. Thirty-one of these schools excluded themselves on various grounds.

The items for the questionnaire were developed after a review of the literature to determine the key issues that should be addressed in the survey. A number of teachers in a junior school known to the author assisted in piloting the questionnaire and some changes were made arising from the pilot study. A meeting with the teachers involved in the pilot study was found to be very useful and as a result of this the wording of some questions was altered and a question was added to the open questions in the final section of the questionnaire. Ethical clearance for the study was obtained from the Research Committee of the institution in which the author works. Findings related to teachers' attitudes form the basis for the paper reported here. The paper also reports on findings related to aspects of pedagogy that teachers wished to develop. Further

information regarding issues such as sampling and piloting is available elsewhere (Dunphy 2007).

The total number of respondents was 266. It could be argued that the true response rate is somewhere between 58% and 77% since it is not known exactly how many schools were eligible to participate on the basis of having children in JI nor is it known exactly how many JI teachers were in each of the participating schools. The response rate was very encouraging, especially in the light of Denscombe's (1998) observation that it is not uncommon to get a response rate of 15% in questionnaire surveys.

## Findings

### *Teacher and school profiles*

The respondents were overwhelmingly female (94%), illustrating the extent to which teaching children in the first year of school in Ireland is predominately a female endeavour. Over a quarter of the teachers in the survey sample had less than five years' teaching experience at any level in primary schools, and a further quarter had less than 10 years' teaching experience. Information related to teachers' early childhood teaching experience is displayed in Table 1.

Table 2 shows the range of class sizes. The majority of children are in classes of greater than 23. In Ireland, schools designated 'disadvantaged' enjoy lower than average pupil-teacher ratios and many of them have a maximum class size of 15. About one-fifth (22%) of teachers classified their schools as having 'disadvantaged' status. Only about 8% of teachers reported that they had a classroom assistant.

It is also important to note that 47% of teachers were working with either one (20%), two (14%) or three (13%) other classes alongside the JI class. The vast majority of teachers used a maths textbook or workbook (96%) with their JI children. This is in keeping with previous findings (Murphy 2004) of widespread use of worksheets and textbooks in senior infant classes; i.e. the second year of primary school, which generally caters for children in the age range 5–6 years of age.

Table 1. Experience teaching infants.

Experience teaching infants	Percentage of respondents
Less than 1 year	10%
Less than 5 years	35%
5–8 years	22%
≥9 years	33%

Table 2. Class sizes.

Class size	Percentage of respondents
≤15	15%
≥16 and ≤22	30%
≥23	55%

## Teachers' challenges and difficulties

Teachers were asked about the difficulties they had encountered in seeking to implement key aspects of mathematics pedagogy in early childhood. For each of these difficulty statements teachers were asked to rate their level of difficulty/challenge on a five-point difficulty rating scale. The findings are presented in Table 3.

Teachers were also asked about their attitudes to a range of mathematical teaching strategies. For each of these agreement statements teachers were asked to indicate the extent to which they agreed or disagreed with it. Relevant findings are presented in Table 4.

More than half of teachers reported no difficulty with the integration of mathematics with other aspects of the curriculum (59%); making mathematics meaningful to young children (58%); providing activity-based mathematical learning (60%); and basing teaching on children's prior-to-school experiences (56%).

Many teachers were also confident about their ability to assess young children's learning (62%). However, what is not known is the nature and extent of that assessment; i.e., whether or not it includes the assessment of processes, attitudes and dispositions

Table 3. Challenges in teaching mathematics in JI.

		Very great difficulty	Great difficulty	Minor difficulty	No difficulty	Undecided
13	Developing the mathematical understanding of children whose first language is not the language of the school	15	27	20	13	25
12	Assisting children who have difficulties with particular concepts	3	23	47	25	2
8	Engaging children in talk about their mathematics (e.g. presenting, arguing and justifying their mathematical ideas)	2	19	41	35	3
10	Documenting children's mathematical learning	2	10	43	40	5
7	Providing opportunities for children to engage in mathematical problem-solving	1	10	46	42	1
4	Building on young children's prior-to-school experiences	1	7	32	56	4
2	Activity-based mathematical learning	0	7	33	60	0
6	Ensuring that children's interest is engaged	0	7	51	42	0
14	Sequencing learning	1	6	41	47	5
3	Making mathematics meaningful to young children	0	6	35	58	1
5	Ensuring that mathematical learning is challenging for young children	0	6	52	40	2
11	Developing children's understanding of mathematical language	0	6	53	41	0
1	The integration of mathematical work with other areas of the curriculum	0	5	35	59	1
9	Assessing children's mathematical learning	0	5	33	62	0

Note: Valid percent figure used from frequency tables.

Table 4. Attitudes to a range of pedagogical approaches.

	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Children talking about mathematics with the teacher helps develop their understanding	70	30	0	0	0
Ensuring children's understanding of the particular use of language in mathematics is an essential part of teaching mathematics in JI classes	70	24	5	1	0
The investigation and presentation of their own mathematical solutions to everyday problems enables children to develop mathematically	41	54	4	1	0
Children in JI should report verbally on their mathematical activity	30	65	3	2	0
Assessment is a critical aspect of providing appropriately challenging mathematical activity for young children	30	57	6	7	0
Justifying mathematical ideas and making mathematical arguments are important at the early stages of learning mathematics*	9	43	21	22	4
Children's ability to use conventional symbols is important in assessing their mathematical ability	4	37	24	31	4
It is important that children represent their mathematics through the use of conventional symbols	2	43	18	33	4

Note: \*This statement was stated negatively in the original questionnaire.

as well as skills and content. Certainly some teachers (41%) appeared to place an emphasis on children's abilities to write and use conventional numerals in assessing their mathematical ability (see Table 4). In relation to the documentation of children's learning, only two-fifths of teachers reported that they were confident in this area of pedagogy.

Assessment strategies based on talk and discussion between children and teacher are central in assessing the learning and development of four- and five-year-old children (Bowman, Donovan, and Burns 2001; Dunphy 2008). While almost all of the teachers (95%) felt that children in JI should report verbally on their mathematics activity (Table 4), over three-fifths of them (62%) reported difficulties in engaging children in talk about their mathematics learning (Table 3). This appears to indicate the potential for conflict between teachers' attitudes and beliefs and their abilities and opportunities to reflect these in their practice.

Similarly, teachers reported very high levels of difficulty in relation to developing the mathematical understanding of children whose first language is not the language of the school. Only about one in ten of them (13%) reported that they experienced no difficulties in this aspect of their teaching. When these difficulties are placed alongside the information that teachers unanimously agree on the necessity for children

talking about mathematics (Table 4), and their strong endorsement of the idea that children's understanding of the particular use of language in mathematics is essential for development, once again the potential for conflict between teachers' beliefs/attitudes and their abilities to reflect these in their practice is revealed. Assisting children who have difficulty with particular concepts was seen as unproblematic by only a quarter of teachers, although only the same proportion saw this aspect as presenting great/very great difficulty for them. While the vast majority of teachers (95%) held the attitude that the investigation and presentation of their own mathematical solutions to everyday problems enables children to develop mathematically (See Table 4), most teachers (57%) reported difficulties in providing opportunities for children to engage in mathematical problem solving (Table 3).

### **Aspects of mathematics pedagogy that JI teachers would most like to develop**

The final section of the questionnaire asked teachers to respond to four open-ended questions. The questions related to goals for teaching mathematics; the development of pedagogy; the factors influencing the organisation and development of children's mathematical learning; and their opinions on the use of mathematical textbooks and workbooks. Teachers' responses to the question related to aspects of pedagogy that they would like to develop, and their reasons for this, are analysed in this paper. Twenty teachers did not respond to the question. The responses of the remaining 93% of teachers were analysed ( $n=246$ ). While there was a great deal of diversity in responses, specific themes did emerge. Teachers in general responded to this question by focusing on either curriculum or processes, or sometimes both. Some focused on the content of the curriculum, i.e. the strands, or on the content of the maths textbooks and workbooks. Of those who wished to develop their teaching in relation to particular strands, most mentioned the teaching of the measure strand as an area that they found challenging ( $n=28$ ). However, it appeared to be the challenge of organising practical activities with a large number of children or in a multi-class situation that was problematic, rather than the content itself. A number of teachers ( $n=24$ ) also indicated that they would like to develop their pedagogy in relation to the Number strand. Eleven teachers were concerned about developing the teaching of the Algebra strand, with fewer worried about their teaching of Shape and Space ( $n=8$ ), or Data ( $n=3$ ).

From the teachers' comments there was a strong sense that the textbooks were dictating the sequence of topics in mathematical learning and teaching in infant classes. Teachers seemed to feel compelled by these, and in some cases appeared to treat them as if they were the curriculum.

Teachers who focused on mathematical processes were most likely to be concerned about developing children's mathematical language and their abilities to talk about their mathematics ( $n=31$ ). The need to ensure that pedagogy included opportunities for children to be actively involved in mathematics learning and use concrete materials was also of great concern to some teachers ( $n=24$ ). However, some teachers indicated that resources for mathematics were a concern and an aspect of pedagogy that needed to be developed in their school ( $n=18$ ). A number of teachers ( $n=20$ ) expressed interest in developing the use of mathematical games with young children and they often identified the benefits of these to children in terms of active learning and of enjoyment. Other aspects of pedagogy that teachers expressed interest in developing were small-group work ( $n=13$ ), assessment ( $n=8$ ), information and communication technology ( $n=7$ ), and the use of the environment ( $n=7$ ).

Teachers frequently explicitly referred to the constraints on their pedagogy as imposed by factors such as class size, the lack of a classroom assistant, the consecutive or multi-class organisation of the school, and space and time issues.

### **Discussion and implications**

The findings of this study indicate that teachers feel that they face a number of challenges in the teaching of mathematics to children in JI classes. The areas that are felt to pose the greatest challenge for teachers include engaging children in problem solving and in the general processes of mathematics; developing the mathematical understanding of children from diverse language backgrounds; supporting children experiencing difficulty with mathematics; and documenting children's mathematical learning.

Recommendations that a high-quality early childhood mathematics programme encompasses general and specific mathematical processes (e.g., problem solving, reasoning, proof, communication) and dispositions (e.g., persistence, curiosity, willingness to experiment) as well as mathematical content are reiterated again and again in the early childhood mathematics literature internationally (Clements, Sarama, and DiBiase 2004; Ginsburg and Golbeck 2004; Perry and Dockett 2006). This issue is also central to the discussion of pedagogical challenges and difficulties facing JI teachers in Ireland. Could it be that teachers think of early childhood mathematics exclusively in terms of content, with talking and thinking about mathematics receiving much less attention in practice? Teachers report that problem solving and the engagement of children in talk and discussion are aspects of pedagogy that they find particularly challenging. While practical and contextual difficulties such as adult-child ratios and multi-class organisational difficulties certainly make these aspects of pedagogy more difficult to enact, teacher beliefs and attitudes are also key factors. If teachers are not convinced of the need for young children to engage in key mathematical processes then it is unlikely that they will try to circumvent any difficulties that arise by seeking to enable children to engage in these processes. Key mathematical processes include justifying mathematical ideas and making mathematical arguments, but almost half of the teachers surveyed here were unconvinced that this was the case at the early stages of learning mathematics (see Table 4).

From the perspective of developing pedagogy in JI classes in Ireland there appears to be a need to address, with or for teachers, the contextual factors that appear to impinge so much on teachers' efforts to implement appropriate pedagogical strategies. These include factors such as class size and the organisation of multi-class teaching where it involves four- and five-year-old children. Teachers in this study clearly indicated that for them, the demands of consecutive- or multi-class teaching often necessitates extensive usage of mathematical workbooks. This appears to imply that in these situations there is consequently less discussion and talk about mathematics, and less active mathematical learning by the children.

It appears that teachers' would benefit from in-service work which focuses both on the role of talk and discussion in mathematics pedagogy, but also on the benefits from the perspective of mathematical learning that can arise from discussion. Working from the principal of starting with what teachers indicate support for, then number games and stories seem a good starting point with teachers to help them build interest in children's talk and develop their skills in listening and understanding. Indeed, this

step seems essential since a few teachers in the study even indicated difficulties in eliciting talk from children.

The need to pay close attention to the approaches used in the mathematics education of young children from culturally and linguistically diverse backgrounds has been identified internationally as a priority for early childhood mathematics education (Perry and Dockett 2004; Ginsburg and Golbeck 2004). The findings above suggest that the skills, abilities and attitudes to teach in increasingly culturally and linguistically diverse classrooms is a key aspect of knowledge for JI teachers in Ireland, as elsewhere. This encompasses the abilities and skills to assess children from diverse backgrounds in appropriate and ethical ways (Espinosa 2005; Dunphy 2008).

Ireland, until recently, had a relatively homogenous population. However, mainly as a result of the enlargement of the EU and with the movement of people from African and eastern-European countries, Ireland now has a substantial percentage of the child population whose first language is not English. A recent report (McGorman and Sugrue 2007) which focuses on the challenges facing intercultural education in one electoral area of Dublin indicates that of the primary-school population there, about one-fifth require English language support (ELS) when they first attend school, with at least a quarter of all children aged 4–5 years of age requiring ELS. The situation is further complicated by the fact that a number of schools in Ireland are Irish-speaking schools (and this is a growing trend), whereas for the vast majority of children English is the spoken language of the home. Difficulties around language are obviously placing great stress on teachers of young children who feel unable to cope with the subsequent challenges in enabling these children to engage fully in the early mathematics curriculum.

Teachers in this study have indicated high levels of support for the interactive style of pedagogy identified by many as critical to early childhood mathematics pedagogy, but they have also indicated difficulties in its implementation. In order to develop and change practice in the Irish context, professional development programmes and curriculum guidelines need to concentrate on ways of helping teachers to develop an interactive type of pedagogy in diverse settings, and with children from diverse backgrounds. Key to this is the need for an explicit statement in the curriculum documents on the necessity for young children to work in small-group teacher-led discussion in order to develop mathematical learning. However, it is first necessary to ensure that teachers are clear about the conditions under which small-group discussion works for young children. Teachers in this study indicated confusion around small-group work, often confusing it with the type of group work that is more suitable for older children; i.e., where the children are organised in groups and work independently of the teacher on an assigned task. Teachers need to be encouraged to move away from the current emphasis on individual work and to put aside the workbooks and worksheets in favour of investigation and discussion of problems and situations of interest to the children. The curriculum must provide examples of how to identify opportunities for problem solving in every-day activities both in and out of the classroom.

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