

**“I’m Participating. Is that Inclusion?” Classroom Learning experiences of  
Mathematics by new entrant children with Down Syndrome**

Abstract

Since a key purpose of schools involves enhancing all children’s culturally-valued skills, tools and knowledge and the provision of equity for children whose access to such learning may be at-risk, it is insufficient to conceptualise inclusion as solely a social or participation issue without examining the quality of those experiences during the various curriculum areas and their potential impact on learning outcomes. This qualitative study investigated the quality of the teaching-learning environment for three new entrant boys with Down Syndrome (DS) at mathematics during their first term at school. Two boys attended regular schools and one attended a school with regular and special classes. The boys were observed using continuous narrative recordings during their mathematics classes and teachers and parents were interviewed. Results indicated that while the teachers endeavoured to include the boys into the maths content, meaningful learning was unlikely to occur. The boys were frequently praised for task-engagement, despite evidence that they had not actually understood the concepts. The teachers’ foci centred mostly on praising for task engagement and for obtaining correct answers as opposed to the underlying processes. In addition, it was found that parents and teachers had different goals for the children and this affected the teaching-learning emphasis. The data suggest a need for teachers to adopt a role of mediators of learning rather than deliverers of curricula and raise issues concerning the meaning of inclusion.

Dr Christine Rietveld  
School of Education  
University of Canterbury  
Christchurch, New Zealand

Paper Presented to NZARE Conference, Wellington. December 2004

The last two decades have seen enhanced societal expectations, more supportive policies (e.g. human rights legislation, Education Act 1989) and improved living, educational and working conditions for people with Down Syndrome (DS). These shifts in policy and practice reflect a reconceptualisation of disability away from the historical focus on the individual and her/his deficits to one that focuses on the role of society, its practices, discourses and policies that have the power to either enable or disable individuals with impairments. Viewing disability as a social construction and/or creation (Oliver, 1996) has become the blueprint for the inclusion of people with impairments in a society that is increasingly striving to value diversity. Recent policies such as the New Zealand Disability Strategy (2001), and the Education Act (1989) are based on the social model of disability, which in terms of education is not only about children's physical inclusion into regular schools, but their meaningful participation in culturally-valued and pedagogically-sound learning processes (facilitative inclusion). These require classroom and school cultures that value diversity and hence support students with and without impairments to engage in valuing, reciprocal and equal relationships that in academic contexts, support one another's learning.

The social construction model shares elements in common with Bronfenbrenner's ecological model, Vygotsky's theory and recent theoretical understandings of learning (Alton-Lee, 2003; Nuthall, 2001) in that all view the quality of interactions the child experiences directly and indirectly in her/his immediate and distal environments significantly impact on learning. While not denying the existence and impacts of impairments such as DS (Baylies, 2002) which need to be understood to optimise the teaching/learning process (Capone, 2004), the social model is potentially more enabling as educators are required to focus on the quality of their teaching/learning contexts, as opposed to blaming students for their deficiencies. The constant interaction of these two influences reflects Bronfenbrenner's (1979) view that biological and within-child characteristics interact simultaneously with contextual variables.

This paper focuses on the learning of mathematics. While inclusion is commonly conceptualised as pertaining to social development, in terms of the purposes of schooling and equity, an exclusive focus on social outcomes is clearly insufficient. An important purpose of schools involves enhancing children's acquisition of culturally-valued skills, tools and knowledge (Alton-Lee, 2003) and providing equity for children whose access to such learning may be restricted (Ministry of Education, 1993). For children with DS who currently reside in and expect to remain in the community throughout their adult lives, the acquisition of mathematical skills such as counting, adding, seriating, estimating size, volume and so forth can contribute to a more enriching life. For instance, being able to read recipes and cook is not only a functional skill requiring mathematical competencies, but mastery can also contribute to feelings of self-worth, enhanced social relationships, a leisure activity/hobby as well as greater independence. Developing mathematical skills can also be justified on the basis of human rights. Policy documents such as the NZ Curriculum Framework (1993) and the NZ Disability Strategy (2001) state that children with impairments are entitled to the same quality education as children without impairments.

Few research studies have examined the mathematical development of children with DS and even fewer the contexts in which such learning has occurred. Those available suggest that mathematical skills are more difficult for children with DS to acquire than those involved in literacy (Buckley, 1985; Irwin, 1989). This is plausible, given the complexities of mathematics are indeed greater than those posed by reading and printing, particularly in light of what is known about the information-processing of children with DS (Marcell & Weeks, 1988; Stratford, 1985; Wagner, Ganiban & Cicchetti, 1990; Wishart & Duffy, 1990). Long-term research has identified important differences in the learning-style, motivation, memory and perception of young children with DS that are likely to impact on their mathematical learning. For instance, the tendency to fixate on single and often irrelevant aspects of tasks (Kasari & Freeman, 2001) and shift attention (Krakow & Kopp, 1982) may make it difficult for the child to view the goal of a task, something necessary for the successful mastery of an activity such as estimating the

number of beads for a particular length of string. Remaining fixated on the string as a potential necklace instead of focusing on the length and its relationship to a quantity of beads to match that length would clearly limit learning. At the same time, it is unclear whether the difficulties posed are intrinsic to the child or a function of ineffective learning contexts.

Given that the available studies concerning the mathematical skills of children with DS focus mainly on their competencies without an in-depth consideration of the wider teacher/learning environment (e.g. Caycho, Gunn & Siegel, 1991, Hunt, 1966; Irwin, 1989), there is a scarcity of information for teachers as to how they might optimally facilitate the development of such skills. This is of particular relevance in light of children with DS mostly attending regular classrooms. The philosophy underlying the inclusion of all learners irrespective of their diversity requires educators and their educational infra-structure to develop pedagogically-sound approaches to facilitate optimal learning outcomes for all students. To enable this to happen requires further understandings of the processes involved. It is intended that the present data contribute to the pool of accumulated knowledge concerning the learning of mathematics in inclusive classrooms. More specifically, the aim of this paper is to outline how each child's immediate and distal school and home contexts facilitated or constrained learning. The data are part of a wider study documenting the transition to school for children with DS that took place from the child's final week at preschool until the end of his first term at school (Rietveld, 2002).

The research questions are:

- 1) How do the boys with DS participate during mathematics time?
- 2) In what kinds of classroom and broader contexts were the 3 boys with DS experiencing the learning of mathematics?

## METHOD

**Participants and Settings:** Three boys with DS, their parents, school teachers and other key people involved with their transition to school participated in this study. Two boys (Ian and Jonathan) were 5-years old and attended the local school of their parents' choice, while 6-year old Mark was enrolled at a non-local school<sup>1</sup> where he spent time in both integrated and special classes. Mathematics took place in the special class. All three boys were observed during their first term at school (approximately 3-4 months).

Ian's class had 16 children on his entry and 22 when observations ceased, while Jonathan's class had 17 on his entry and 28 at the conclusion of the study. Officially, there were 6 children in Mark's class, although sometimes there were up to 9 children present, as others considered 'not coping' in the regular classes spent portions of their time in the special class.

**Procedure:** The children and teachers' behaviours during mathematics were observed at their respective schools through direct continuous narrative recording observations. The belief systems, attitudes and accompanying practices of the teachers, teacher-aides and parents were obtained through informal discussions, field notes, observations of meetings and semi-structured interviews.

At school, a mathematics session began when the teacher announced its beginning. For example, "For mathematics today, we..." The child also had to be present and ready to participate (not for example completing the previous activity or be assigned to go elsewhere). Mathematics concluded when all the equipment was put away and/or the teacher announced the next activity.

**Inclusion of Mathematics Sessions:** Eight mathematics sessions were included for Ian, which had a mean length of 26 minutes each. For Jonathan, there were six sessions with

---

<sup>1</sup> This was not the parents' preferred choice. Mark had been rejected at several local schools.

a mean length of 18 minutes and for Mark, there were three sessions, which lasted approximately 43 minutes each.

**Data Analysis:** The data were analysed inductively. Recurring themes and sub-themes pertinent to the learning of mathematics were extracted from all the original observations on each child. In the microsystem of the classroom, the major theme was ‘instructional issues’, which involved how the child responded, what the teacher did and how peers interacted with and about the child. Sub-themes at the micro-level included: error awareness, self-correction, the implicit nature of tasks and the type of feedback provided by teachers. Data concerning distal factors impinging on each child’s mathematical development were obtained from the interview data with the children’s parents, teachers and teacher-aides. Themes from these data focused on: the quality of the child’s overall experiences at school, lack of appropriate professional support pertaining to the learning of mathematics, teacher beliefs about the purposes of inclusion and value of learning mathematics for children with DS.

## RESULTS

The data are presented in the following order: 1) a summary of the mathematical skills and recurring behaviour displayed during mathematics by the boys with DS and 2) the immediate classroom context experienced by each of the boys followed by the distal contexts impacting on their mathematical learning.

### Child’s Skills on School Entry and Behaviour during Mathematics

The number skills of all the boys with DS during regular classroom activities were primitive and fragile and possibly more like 2-3 year olds rather than 4-5 year olds (Gelman & Gallistel, 1978). Some of the basic principles were not well understood or enacted (for example, the cardinality principle that all items need to be counted, but only once) and a critical skill necessary to improve performance (the ability to self-check) was absent in all but one child (Jonathan). Error awareness and self-checking are critical skills for improving performance. At the same time, the abilities of the children with DS

were not uniform. Jonathan showed the beginnings of metacognition and Ian had a stronger interest in mathematics, which was reflected in a higher levels of competence, initiation and use of mathematical skills than the other two boys. Teaching the boys with DS posed some unique challenges. While they actively engaged in the tasks most of the time, at other times, they resisted participation in tasks they perceived as challenging in similar ways to the infants with DS in Wishart and Duffy's (1990) research. They also failed to respond to motivational strategies that often worked for typically developing children (e.g. "Let's see whose ready first").

The following case studies highlight how these within-child characteristics interacted with contextual factors to contribute to a less than optimal context for the learning of mathematics.

### **Case Studies**

#### **Ian**

*Quality of inclusion:* Overall, Ian experienced facilitative inclusion in that he engaged in the same range of social roles, including friendships as his typically developing classmates. His school viewed inclusion as changing the mainstream culture as opposed to expecting children to assimilate into an existing culture. Practices were changed not only for Ian but also for the increasing heterogeneity in the school population. A benefit of the principal's decision to select a trained teacher as teacher-aide for Ian's class was the opportunity it provided for the teacher to divide the class into two units of eight pupils at mathematics time, to ensure maximal amounts of attention for all the children. The teacher-aide structuring pairs or groups of three to undertake activities together promoted opportunities for social inclusion. Because the children in Ian's group were carefully selected with regard to maturity, Ian consistently experienced appropriate role models in terms of behaviour and engagement in the required tasks as well as a safe environment in which to learn. Considerable attention was focused at the beginning of Ian's entry on how/where to sit and how to interact. As the children internalised these expectations, less

teacher attention was needed for these issues and the time was more fully devoted to the mathematical content.

*Ian's experiences during mathematics:* Unlike the more interactive teaching, which took place during literacy, mathematics instruction was more one-directional. Children including Ian were expected to engage in specific tasks requiring right answers, but often they were not given access to the kinds of processes necessary for producing those answers. The following incident illustrates Ian's active participation in a task, but no access to information concerning the nature of his errors and how to improve his performance.

The group had played number memory and at the end of the game, the teacher-aide asked each child to count the total number of cards in their respective sets. Ian had 4 cards and correctly counted '4.' The teacher-aide then asked, "So how many have you got?" (cardinality principle) to which Ian replied, "6." The teacher-aide repeated the question several more times and on each occasion, Ian busily counted, "1, 2, 3, 4" correctly. After each counting of his set, the teacher-aide again asked for the cardinal number (So how many have you got?) to which Ian would reply "6." Ian did not know that the last number counted becomes the cardinal number of the set and the teacher-aide did not identify or provide the information to correct the error.

Another feature of Ian's instructional environment was that he was frequently praised for obtaining the 'right' answer when observations indicated that he had not developed the thinking processes intended to produce those 'right' answers. Ian would imitate the previous child's answer, which gave the impression that he had understood. For example, during the following episode, the teacher-aide asked each child to compare the counters in their hand with the counters in their line.

The teacher-aide asked Lucy (who was before Ian), "Do you think you might have not enough or too many?" She glanced at her line, then at her handful of counters and replied, "Too many." The teacher-aide asked Ian, "What about you, Ian?" Ian also replied, "Too many." This was correct and he was praised for his answer. However, he answered without looking at either his pile or handful. When later he was told to "Match them (the counters) up and see" (to see if he had sufficient counters), he did nothing.

This suggested that he did not actually know what he was comparing when asked to predict the equivalence of a set of random counters against his existing set.

Peers also used the same approach as the teacher and teacher-aide in that they reinforced Ian's participation, which mitigated against his inclusion into the task content. For example, the teacher-aide asked her group to stand beside something that was taller than them. The group dispersed and stood beside taller items except Ian who stood beside the same item another child selected. Ian's friend, Elliot called out to Ian, "Here Ian." (pointing to a bookcase which was taller than Ian). Ian walked to the bookcase and the teacher-aide praised him ("Good boy") without checking that Ian had understood what "taller" meant. Examples like this raise of what inclusion really means and this will be addressed later.

*Distal factors affecting Ian's mathematical development:* The lack of appropriate professional support for the teachers and family was a significant shortcoming. The itinerant professional's 'support' was not utilised on the basis that it stemmed from the historical personal tragedy view of disability, which was in conflict with the school and family's goals. Ian's mother was concerned about the dearth of suitable expertise available after leaving the early intervention programme.

"I feel a bit helpless because I've always known what he needs to learn and been able to involve it in day-to-day things, whereas now I can't really...I sort of feel in limbo... I still wish I could have someone who could give me things, warn me, you know like MM (therapist at early intervention). The teacher's new to it too."

While both the teacher and teacher-aide were committed to providing an optimal inclusive learning context, in mathematics they seemed unaware of how Ian frequently obtained the right answers without understanding the underlying processes or how he was deprived of information he needed to enhance his learning. If they had been more aware, it is doubtful whether they would have described his competencies as follows:

"He's very good at maths itself, but maths language is very difficult for him"  
(Teacher-aide).

“He’s very good at some maths ideas, possibly where he’s had prior learning or where he may just have a natural ability for some types of things, like counting” (Teacher).

Perhaps a combination of no suitable professional expertise, the teacher and teacher-aide not knowing how to optimally facilitate Ian’s development whilst simultaneously managing the peer group and a curriculum that has traditionally favoured a focus on obtaining correct solutions as opposed to underlying processes (Biddulph & Taylor, 1995) have all contributed to a less than optimal teaching context.

### **Mark**

*Quality of inclusion:* Mark did not experience facilitative inclusion in either his special or regular class and was mostly ignored by his peers. He experienced no peer interaction during mathematics.

*Mark’s experiences during mathematics:* The curriculum in Mark’s special class was presented in a non-linear manner. A variety of themes were undertaken on a weekly basis (e.g. shapes, colours, numbers). Within these themes, there was no match between what Mark could do and the kinds of tasks he engaged in. For instance, the lesson on Number 2 confused Mark because it required more advanced skills than he possessed. Mark was still at the stage of counting distinctly separate objects in a row when he could physically move or touch them. This task required the recognition and pasting of sets of 2 from magazine pictures such as, legs, arms and eyes while on the same sheet there was 1 baby because it had 2 lips, 2 eyes etc. The confusion was compounded by the addition of unrelated pairs of inanimate objects (e.g. 2 apples). Given children with DS’s acknowledged difficulties in focusing on salient aspects and dealing with multiple dimensions simultaneously, this learning experience in which no overt connections were made between his current abilities and the task is likely to have constrained rather than extended Mark’s understanding of the concept 2.

The mathematics concepts involved in the activities often contained multiple dimensions. The children needed to exclude simultaneously the irrelevant dimensions and identify the relevant task components. The process of understanding was further hampered by the disparate nature of the teaching materials, such as using different media to illustrate “thickness” instead of two of a kind. For instance, to illustrate ‘thick/thin’, the teacher used examples of wool, paint, bangles, cardboard and books. Mark could not make the necessary connections between the key concept (thick or thin) in view of the varying textures presented, and his teacher failed to recognise his lack of understanding. This issue is illustrated in the following episode.

Teacher - Mark, “Do you want thick or thin paint? You tell me.” The teacher shows him the 2 containers (one of thin red paint, the other of thick yellow paint). Mark points to the red thin paint and vocalises hesitatingly. The teacher asks him again, “Thick or thin?” Again Mark vocalises hesitatingly. Teacher - Mark, “I can’t hear. Thick or thin? You choose.” Mark says, “Paint.” Teacher - Mark, “You can have some paint.” Mark vocalises, then leans forward to reach a container of paint. The teacher stops him and shows him the two containers asking again, “Thick or thin?” Mark replies, “Thin.” Teacher - Mark, “Good boy” and gives him the thin paint. He starts painting. The teacher spends the next seven minutes labelling Mark’s use of the thick or thin paint depending on which he is using. To her final comment, “What a lovely thick yellow painting and here’s your thick yellow paint”, Mark yells out, “No! Shut up!”

While the teacher’s aim was to facilitate Mark’s learning of the concept, he did not understand it. Even though the teacher had used the words repeatedly, Mark did not have any hands-on experience with suitable concrete materials, which encouraged specific focus on the concept being taught assisted by appropriate teacher dialogue. The teacher praised his participation (when Mark finally imitated the word she required – thin), even though he did not know its meaning. Instead of viewing Mark’s hesitancy as a function of his lack of understanding for which she needed to alter her teaching, his teacher interpreted it as his lack of compliance as she required him to make a choice (between the 2 consistencies).

Mark did not use any self-checking skills and their acquisition was not facilitated. For example, when Mark was required to pick up a square, he picked up a circle (the nearest

shape) and the teacher informed him that this was not a square. He returned the circle and picked up the next-nearest shape (a square) and was praised for this. He did not appear to check the shape, nor was he required to do so. Mark's understanding of the concept (square) was not checked out.

*Distal factors affecting Mark's mathematical development:* Generally, Mark's teacher did not see mathematics or other academic skills as a priority for Mark or the children in her class,

“I see social skills as number one priority – getting on socially and then the academic will come. I don't get uptight about not teaching academic skills.”

This may have influenced her decision to not utilise any professional expertise, although it is doubtful whether they could have facilitated his learning as their focus was on behaviour management. Whilst Mark's parents wanted him to develop new mathematical understandings, they did not know what he was doing in mathematics, expecting the teacher to inform them like she did with other homework.

“I don't know whether he's doing that yet (mathematics). I wouldn't have a clue” (Mother, 4 months after school entry).

Not knowing what Mark was being taught in mathematics at school inevitably restricted opportunities for generalising and consolidating these skills.

### **Jonathan**

*Quality of inclusion:* Jonathan was physically present, but psychologically excluded as a valued member of his class. Unlike Mark who was largely ignored, Jonathan was not. Throughout the school day, he was frequently the target for harassment both overtly and covertly. His peers considered him a deviant member ('not like us' – “There's something wrong with him” according to one peer). Jonathan's parents were unhappy not only about their son's experiences of exclusion, but the school's resistance in establishing any meaningful dialogue with them in order to resolve the issues. Unlike Ian's school who viewed inclusion as changing their ethos and practices to enable a more diverse range of

students to actively participate, Jonathan's principal and teacher viewed inclusion as children with impairments assimilating into the existing school culture as indicated by Jonathan's teacher at the end of his first term. "I wouldn't change anything." Jonathan's teacher-aide was not present in the classroom during mathematics.

*Jonathan's experiences during mathematics:* Jonathan's teacher divided the class into three groups of 6-9 children and Jonathan was placed in a group of the newest entrants, most of who lacked the behavioural skills required to profit from instruction in the way it was presented. Unlike Ian's class, procedural and social norms were never specified and hence internalised. During activities, he was never selected as a potential partner. Sometimes the teacher insisted a particular child work with Jonathan despite her/his displeasure. However, the partner made no or minimal attempts to engage him in the task. Jonathan's interactions were ignored. For instance, on one occasion, he asked for some equipment ("Me please?") and held out his hand for some of the blocks. The partner ignored Jonathan's audible request. On another occasion, Jonathan's partner included him in the task content in the manner prescribed by the teacher, but the attempt failed because the instructions were not meaningful to Jonathan and his partner did not find another suitable method of engaging him.

The harassment that took place throughout other aspects of the school day continued during the small group mathematical activities and in the larger group, particularly when the teacher was not looking. For instance,

The teacher is showing the class a picture depicting a variety of shapes and asks individuals to point out specific shapes. Jonathan attends. Simon has illustrated something and the teacher asks him to return to the mat as she attends to a visitor. Jonathan remains focused on the picture. As Simon returns to his space passing Jonathan he says to him, "You're naughty. You're a naughty boy."

On another occasion as the teacher explained the next maths task to which Jonathan was attending, another classmate (Gerard) calls out publicly, "Michael's a pest isn't he and so is Jonathan". This comment highlights the deviant status assigned to these two boys with identifiable impairments. Interactions stemming from this belief are likely to be

incompatible with any meaningful interaction concerning the actual maths content. The teacher did not challenge this pervasive belief.

Often, the majority in Jonathan's group did not engage in the assigned tasks, and either the teacher did not address this or attended reactively to it. The teacher's reactive than proactive management had major implications for Jonathan. Given his DS, he had greater difficulty attending to the relevant cues and ascertaining in which context it was appropriate to engage in which behaviour. His frequent exposure to inappropriate peer models contributed to Jonathan's internalisation of such behaviour, which compounded his peers' negative perceptions of him, resulted in less task engagement, his adoption of an alternate role for himself (class clown) and exclusion from any potential mathematical learnings.

In the whole-class situation, the teacher often failed to make the instructions of tasks explicit. Failure to do so precluded Jonathan's inclusion into the task content and also meant that he was not able to show his competencies, something, which had the potential to alter his peers' perceptions of him. For example, Jonathan could identify and label shapes in real and picture form. However, he did not respond to the question, "Who hasn't had a turn and would like a turn at showing me something (a shape)?" Although it was probably self-evident to others that she was talking about shapes as previous children had pointed out shapes on the large picture, it seemed unlikely that Jonathan made this connection.

Essentially, the instructional context of the teaching (as in other implicit and formal curriculum areas) precluded Jonathan's academic inclusion in mathematics. Jonathan and his peers could not get into the mathematical content, because peer interactions remained concerned about the nature of the relationship and could not move beyond that point without assistance and altering existing classroom norms.

*Distal factors affecting Jonathan's mathematical development:* Jonathan's parent's beliefs about inclusion and expectations for Jonathan differed philosophically from those

of the school. Despite many attempts at setting up meetings and their offering of support to the teacher and teacher-aide, the differences in perspectives about inclusion at a deeper level seemed to hinder any meaningful communication about individual subjects such as mathematics. In the absence of any overall goals for Jonathan's development in mathematics, Jonathan's parents reported uncertainty concerning how best to facilitate his mathematical development.

Like Mark's teacher, Jonathan's teacher did not prioritise facilitating Jonathan's academic development.

“To me, that was the most important thing – that social side of things.”

The itinerant professional supported the teacher's stance. Her background in special education reflected the traditional deficit approach and accordingly, her suggestions focused on assimilating Jonathan into the existing classroom culture by modifying his social behaviour. There were no specific mathematics goals established at the IEP meeting, the goal being his “participation in all activities” without attention to the quality of that participation and its potential impact on learning.

### **Summary**

The case studies highlight significant barriers in the children's immediate and distal teaching/learning contexts that are likely to have hindered access to their acquisition of more advanced mathematical understandings. The children were not helped to develop error awareness or self-checking and the implicit aspects of tasks were never made explicit. They were regularly praised for being busy and on-task, but it is unlikely that they knew what they were being praised for. In Ian's classroom, peers deprived Ian of opportunities for learning by socially including him. In Jonathan's room, the kind of exclusion operating throughout the entire school day failed to provide an appropriate infra-structure for him to learn any mathematical content, let alone for peers to reframe their views of him as deviant to valued classmate. There was also no monitoring of any of the children's teaching-learning contexts by professionals. The professional guidance

that was available for the teachers and parents focused on managing ‘deviant’ behaviour rather than the teaching and learning process. This hindered any meaningful establishment and congruity of learning goals.

## **DISCUSSION**

Disability is currently defined in terms of societal practices, discourses and policies that hinder meaningful participation (New Zealand Disability Strategy, 2001). In terms of meaningful participation of these three new entrants with DS during mathematics, the data indicate that disabling barriers to effective learning exist through particular practices and discourses that fail to take into account: the unique learning characteristics of the child (with DS), the child’s existing skills/strengths, equity issues (Mark and Jonathan) and the quality of peer interactions which in all cases undermined the mathematical learning process. The most common shortfall was the lack of access these children with DS had to the kinds of information needed to enhance their understandings. This was evident by the way the children were rewarded consistently by teachers for participating rather than for engaging in meaningful learning. Given that children with DS have fewer neurological pathways to receive and send information (Capone, 2004) their ability to make incidental connections using previous/present clues are more limited (Stratford, 1985; Wishart & Duffy, 1990). Therefore, effective teacher-initiated feedback is even more critical than for typically developing children. The data suggest that teachers need to establish some inter-subjectivity with the child to enable scaffolding of more advanced thinking (Vygotsky, 1978). Providing answers for mere participation hinders this process.

Because how children experience inclusion determines to a large extent their access to culturally-valued tools, skills and knowledge (Vygotsky, 1978), it is essential that social relationships are supportive. A major barrier to learning mathematical content for all three boys involved the quality of peer interactions. The non-supportive interactions experienced by Jonathan resulted in an unsafe context that was not conducive to any meaningful learning. This highlights the importance of establishing and enforcing school norms that accommodate children who behave and/or communicate in diverse ways. In

Mark and Jonathan's schools, there was no infrastructure to facilitate social inclusion and so these boys were excluded from the overall classroom culture. Since effective teaching and learning requires belonging as a valued participant as a co-requisite (Rogoff, 1990; Vygotsky, 1981), facilitating Mark and Jonathan's mathematical development would require attention to not only effective teaching of the mathematical content, but the fundamental social processes operating, so these boys could experience belonging as valued participants and experience potentially supportive peer interactions. However, as Ian's data indicate, social inclusion during academic tasks is insufficient on its own if these relationships undermine learning. An implication of this is that teachers need to integrate the facilitation of appropriate peer interactions relevant to the curriculum areas throughout their teaching of content. This requires teachers (and itinerant support professionals) to distinguish facilitative from demeaning inclusion

In all three case studies there were incidents of peers avoiding (Mark and Jonathan), engaging in overly-kind (Ian) or hostile interactions (Jonathan). Such interactions not only hinder the mathematical learnings intended, but also provide an example of how contexts disable, thus lending support for the social model of disability. Peers can learn to respond in ways that are both socially and academically inclusive as indicated in literacy and social studies (Rietveld, 1996; Rex, 2002). Teachers may need greater awareness of how they might alter the social context, an issue that Ian's teacher and teacher-aide were very open to, but unfortunately, there was no appropriate professional to provide them with this kind of feedback and support.

Incidents of teachers praising children without checking that they had understood the concept(s) raise the issue of what inclusion really means. While Ian was socially included in the range of social interactions particular to the group, which include belonging as a valued member and having friends, inclusion must also involve authentic engagement in academic learning tasks, given that the acquisition of culturally-valued skills is viewed as a key purpose of schools for all students (Alton-Lee, 2003; Wenger, 1998). However, given the prevalence of the historical personal deficit model of disability, it is hardly surprising that teachers have personal views on this issue in

relation to children with impairments as evidenced by Mark and Jonathan's teachers who did not consider the learning of mathematics as important. Teachers also receive mixed messages from policy documents concerning this issue as evident in the New Zealand Curriculum Science Framework (1993) where a range of culturally-valued educational outcomes are specified for other minority (assumedly non-disabled groups), such as girls and Maori. However, in relation to children with impairments, all that is required of them is participation. "They are given encouragement and support to enable them to participate as fully as possible" (p. 13).

The data suggest that the concept of labelling a school as 'inclusive' makes no sense, yet this occurs frequently in the literature (e.g. Hall & McGregor, 2000; Staub, Schwartz, Gallucci & Peck, 1994). Facilitative inclusion is context-specific as evident in Ian's school where the vast majority of the school's practices were inclusive and Ian experienced facilitative inclusion including advancement in literacy in all other observed contexts. However, his experiences of exclusion from the content of the maths instruction lends support to Ainscow & Booth's (1998) criticism of an 'inclusive' school. They argue that, "an inclusive school is an ideal never fully attained and inclusion is about changing processes; enhancing processes; enhancing participation and reducing exclusionary processes" (pp 97-98). The data suggest that authentic and meaningful inclusion would seem to be context-specific and closer attention to how children experience inclusion in all curriculum areas by professionals supporting teachers, children and families could help ensure children receive facilitative experiences across all contexts.

Teachers and trainee teachers have expressed concerns about their lack of confidence in teaching children with DS (and other impairments) and the lack of quality professional support and infrastructure to implement inclusive education (Rietveld, 1989; 1996; Forest & Pearpoint, 1993; Wishart & Manning, 1996). The data indicate that this is a very real issue and needs urgent addressing. The psychologists and advisors available to all these schools supported practices reflective of the historical deficit or individual model of disability. If teachers are to facilitate meaningful learning outcomes for all

children in their classrooms, then it is essential that they have access to professional support, who are familiar with the philosophy underlying inclusion both theoretically and practically as well as conversant with children's learning of mathematics. At the same time, since the experiences of children with DS are mediated by their biological conditions, support professionals must be cognisant of these effects on learning as well as ensuring congruity between policy, philosophy and practice across home and school settings. Appropriate professional support has the advantage of improving teachers' instructional competencies, which has the potential to benefit other children who are struggling to understand mathematical concepts.

Shortcomings in one or more curriculum areas have the potential to impact on the quality of experiences and learning in other areas as children's lives cannot be compartmentalised into discrete segments. For instance, ongoing authentic inclusion in the playground may be at-risk when games and sports become more complex and involve a higher level of numeracy skills. If the child has failed to acquire such skills through an ineffective learning environment, then his/her overall quality of life and advancement of other skills may also therefore be compromised (Biklen & Knoll, 1987; Billingsley & Albertson, 1999).

While this study has indicated a number of disabling barriers both within the child (lower level of skill development and specific-information-processing differences) and the teaching-learning environment, it is subject to limitations. The data were gathered as part of a wider exploratory study of children with DS during their transition to school. Consequently, it is based on a limited amount of mathematical data. It is not known how representative the observed experiences are in relation to the total number of mathematical episodes throughout the entire term. The small number of children who were all of the same gender also limits the findings. How representative these children and their classrooms are is another unknown factor. Future studies would also benefit from ascertaining the children's progress over time, so that the effects of the teaching-learning environment could be more accurately investigated.

## REFERENCES

- Ainscow, M. & Booth, T. (1998). New Zealand response: one philosophy or two? In T. Booth, & M. Ainscow (Eds.), From them to us: an international study of inclusion in education (pp. 95-100). London: Routledge.
- Alton-Lee, A. (2003). Quality teaching for diverse students in schooling: Best evidence synthesis. Wellington: Ministry of Education,
- Baylies, C. (2002). Disability and the notion of human development: questions of rights and capabilities. Disability and Society, 17(7), 725-739.
- Biklen, D., & Knoll, J. (1987). The disabled minority. In S.J. Taylor, D. Biklen, & J. Knoll (Eds.), Community integration for people with severe disabilities (pp. 3-24). New York: Teachers College Press.
- Biddulph, F., & Taylor, M. (1995). An introduction to mathematics education. In H. Barr, & P. Gordon. (Eds.), The curriculum in the classroom (pp. 99-108). Palmerston North: Dunmore.
- Billingsley, F.F., & Albertson, L.R. (1999). Finding a future for functional skills. Journal of the Association for Persons with Severe Handicaps, 24(4), 298-302.
- Bronfenbrenner, U. (1979). The ecology of human development. Harvard: Harvard University Press.
- Buckley, S. (1985). Attaining basic educational skills: reading, writing and number. In D. Lane & B. Stratford (Eds.), Current approaches to down's syndrome (pp. 315-343). London: Holt, Rinehart & Winston.
- Capone, G.T. (2004). Down Syndrome: Genetic insights and thoughts on early intervention. Infants and Young Children, 17(1), 45-58.
- Caycho, L., Gunn, P., & Siegal, M. (1991). Counting by children with Down Syndrome. American Journal of Mental Retardation, 95(5), 575-583.
- Education Act 1989, Sections 8,9,10. Statutes of New Zealand.
- Forest, M., & Pearpoint, J. (1993). Inclusion! The bigger picture. In J. Pearpoint, M. Forest, & J. Snow (Eds.), The inclusion papers: strategies to make inclusion work (pp. 1-3). Toronto: Inclusion Press.
- Gelman, R., & Gallistel, C.R. (1978). The child's understanding of number. Cambridge, MA: Harvard Press.

- Hall, L., & McGregor, J. A. (2000). A follow-up study of the peer relationships of children with disabilities in an inclusive school. The Journal of Special Education, 34(3), 114-126.
- Hunt, N.(1967). The world of Nigel Hunt. Bucks, Darwen Finlayson Ltd.
- Irwin, K. (1989). The school achievement of children with down syndrome. The New Zealand Medical Journal, 2(860), 11-13.
- Kasari, C., & Freeman, S.F.N. (2001). Task-related social behavior in children with down syndrome. American Journal of Mental Retardation, 106(3), 253-264.
- Krakov, J.B., & Kopp, C.B. (1982). Sustained attention in young down's syndrome children. Topics in Early Childhood Special Education, 2(2), 32-42.
- Kunc, N. (1992). The need to belong: rediscovering Maslow's hierarchy of needs. In R. Villa, J.S. Thousand, W. Stainback & S. Stainback (Eds.), Restructuring for caring and effective education (pp. 25-39). Baltimore: Paul H. Brookes.
- Marcell, M.M., & Weeks, S.I. (1988). Short-term memory difficulties and down's syndrome. Journal of Mental Deficiency Research, 32(2), 153-162.
- Maslow, A. (1970). Motivation and personality. New York: Harper & Row.
- Minister for Disability Issues. (2001). Making a world of difference: the New Zealand disability strategy. Wellington: Ministry of Health.
- Ministry of Education. (1993). Science in the The New Zealand curriculum. Learning Media: Wellington.
- Ministry of Education. (1993). The New Zealand curriculum framework. Learning Media: Wellington.
- Nuthall, G.A. (2001, December). Understanding the role of culture and myth in teaching and learning: a personal journey. Paper presented to the New Zealand Association for Research in Education Conference, Christchurch Polytechnic, New Zealand.
- Oliver, M. (1996). Understanding disability: from theory to practice. New York: St Martin's Press.
- Rex, L.A. (2000). Judy constructs a genuine question: a case for interactional inclusion. Teacher and Teacher Education, 16(3), 315-333.

- Rietveld, C.M. (1989). An evaluation of 7 to 12 year old children with down's syndrome in home and school settings: a follow-up study of children from the Christchurch early intervention programme. Research Report No. 89-1. Education Department, University of Canterbury, New Zealand.
- Rietveld, C.M. (1996, December). The development of literacy skills in children with down syndrome during their transition from preschool to school. Paper presented at NZARE conference, Nelson, New Zealand.
- Rietveld, C.M. (2002). The Transition from preschool to school for children with down syndrome: A challenge to regular education? Unpublished PhD thesis, Education Department, University of Canterbury, Christchurch, New Zealand.
- Rogoff, B. (1990). Apprenticeship in thinking. New York: Oxford University Press.
- Staub, D., Schwartz, I.S., Galluci, C., & Peck, C.A. (1994). Four portraits of friendship at an inclusive school. Journal of the Association for Persons with Severe Handicaps, 19(4), 314-325.
- Stratford, B. (1985). Learning and knowing: the education of down's syndrome children. In D. Lane, & B. Stratford (Eds.), Current approaches to down's syndrome (pp. 149-166). London: Holt, Rinehart & Winston.
- Vygotsky, L.S. (1978). Mind in society: the development of higher mental processes. Cambridge, Mass., Harvard University Press.
- Vygotsky, L.S. (1981). The genesis of higher mental functions. In J.V. Wertsch (Ed.), The concept of activity in Soviet Psychology. Armonk, New York: Sharpe.
- Wagner, S., Ganiban, J.M., & Cicchetti, D. (1990). Attention memory, and perception in infants with down syndrome: a review and commentary. In D. Cicchetti, & M. Beeghly (Eds.), Children with down syndrome: a developmental perspective (pp. 147-179). New York: Cambridge University Press.
- Wenger, E. (1998). Communities of practice: learning, meaning and identity. Cambridge: Cambridge University Press.
- Wishart, J.G., & Duffy, L. (1990). Instability of performance on cognitive tests in infants and young children with down's syndrome. British Journal of Educational Psychology, 60(1), 10-22.
- Wishart, J.G., & Manning, G. (1996). Trainee teachers' attitudes to inclusive education for children with down's syndrome. Journal of Intellectual Disability Research, 40(1), 56-65.