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South African Research Association for Early Childhood Education (SARAECE)

The Early Childhood Education (ECE) field is currently disempowered by its fragmentation into smaller interest groups without a unified voice or vision. An inclusive association with a strong research base and focus was identified as a need to represent the field in a purposeful manner.

The first international ECE conference took place from 1-3 February 2011, and was hosted by the subject group foundation phase, Faculty Education Sciences from the North-West University, Potchefstroom. The intention of the conference was to bring people in the field of ECE together and to establish an association for research training and development. Drs Green and Parker of the Department of Higher Education and Training (DHET) attended a session. There was a general support for the establishment of such an association, and it was proposed that the DHET call a workshop meeting to which a representative from each of the universities involved in teacher training would be invited. A meeting was called by the DHET for 20 universities and 16 representatives from education faculties in South Africa attended the meeting on 11 May 2011 in Johannesburg. The idea to establish a research association for the ECE sector was again unanimously and strongly supported. A task team was elected to draw up a draft document and constitution.

A proposal by a task team recommended the establishment of the South African Research Association for Early Childhood Education (SARAECE) for young children (0-9) in South Africa. The association seeks to be a leading voice for ECE invested in improving the well-being, early education and developmental potential for all children from birth to Grade 3. The association would serve as a catalyst for research, programme and materials development. The association intends to provide a platform that supports knowledge creation in ECE and is committed to becoming an inclusive, collective and critical voice for the ECE field.

The key activities of the SARAECE will include the following:
1. Research in the ECE field.
2. Collaboration between members and with both local and international bodies and individuals involved in SARAECE.
3. Advocacy of the specific intent and projects of the SARAECE.
4. Informing practice through support and involvement of both pre- and in-service educators as well as staff of colleges and universities involved in the training and education of ECE practitioners and teachers.
5. Being responsible for implementing directives from its constituency such as the hosting of conferences and/or initiating projects to advance its causes.
6. Supporting the *South African Journal of Childhood Education (SAJCE)* with the specific intent of promoting research in both the academic and professional fields of SARAECE.
7. Encourage and initiate the design and distribution of publications with parent information pieces.
8. Encourage cascading of the association to provinces.

Membership of the association will be open to any institution and/or person who have an interest and agency to promote ECE through research and subscribing to the aims of the association as described above.

During the UJ Literacy Winter School in July 2011, members representing the five main regions of South Africa was elected as a steering committee for SARAECE.

The members of the steering committee are:
Dr Ona Janse van Rensburg (President, NWU)
Prof. Hasina Ebrahim (Vice President, UFS)
Dr Ursula Hoadley (CPUT)
Prof. Jean Baxen (Rhodes)
Ms Lorayne Excell (Wits)
Ms Nici Rousseau (CPUT)
Ms Robin Notshulwana (Secretary, NMMU)
Dr Mamosebatho Ramabenyane (UFS)
Dr Mamsi Khuzwayo (UZ)
Dr Seenie Naidu (UNISA)
Dr T. Mbatha (KZN)
Prof. Elizabeth Henning (UJ: Editor SAJCE)

The next meeting of most of the members of SARAECE will be from 10 to 14 September 2012 at the Early Childhood Education Research and Development week hosted by RU in Grahamstown. The website of SARAECE will soon be available.

**Contact details:**
Email: saraece.org@gmail.com
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Editorial: Building Communities of Research

This issue gives a glimpse of some of the burning issues in childhood education. Authors discuss themes ranging from pre-school education, the transition from one phase in childhood education to the next, the ECD sector, and the education of teachers of young children.

In her extended literature review, which we include as the leading article, Fitzpatrick reviews the literature on school readiness and discusses the results. The editors selected this lengthy article because we believe that the literature she included in her research, with the detailed discussion, will be of use to the many new researchers in childhood education, and specifically foundation phase education. This review could also be of use to teacher education for the early grades, a topic that Dixon et al. researched from the side of lecturers for such programmes. Their article gives a glimpse of how mentoring can be seen to build a community of practice in teacher education, with lecturers from two universities building collaboration and support. This article is one of the first to be published in an important venture of the department of higher education and training (DHET) in which a critical mass of academics are nurtured to lead foundation phase teacher education in the future.

In each issue of this journal, we are bound to find articles on the teaching of mathematics and on children’s learning. In her article, Graven gives a fresh view of the mathematics proficiency of learners in Grade 3. She describes how researchers are afforded the opportunity to investigate mathematics dispositions in depth at a ‘maths club’, making for truly interesting reading of the cases she describes.

When Stears and her co-authors investigate how teachers implement the science curriculum in the early years of schooling, they use a framework, which reminds one of Vygotsky’s idea of a ‘zone of proximal development’ for individual learning. They utilise the notion of a ‘zone of feasible innovation’ to explore how teachers implement the science curriculum within, and integrated with other subjects of, the life skills curriculum. Not surprisingly they conclude that the ‘innovation zone’ of the teachers differ and that this task is challenging. Complementing the previous article, James and co-authors report on science learning in Grade R in three different school settings, showing that the teachers’ knowledge of science, and the school contexts are the main variables in the type of science learning that is taking place in these schools.

Henning and Dampier report on a study of Grade 1 children’s language competence, arguing that school discourse requires some stability and that young learners in classrooms where there is shifting language may experience unduly long periods of what anthropologists refer to as ‘liminality’. This article wishes to contribute to the important debate on the medium of classroom communication in multilingual schools.

The last two articles in this issue take the reader to the vibrant world of ECD. Atmore, Van Niekerk and Ashley-Cooper’s contribution to this issue is, like Fitzpatrick’s an extensive source of review information that can be used by researchers in the ECD field.
Van der Vyver's article shows how educational development work in ECD is always part of a much bigger picture in which not only financial sponsorship, but also community emancipation play a role in getting lay practitioners prepared for ECD practice that goes beyond mere day-care.

If the harvest of research articles in this issue is a sign of where the journal is heading, we will in due course be able to apply for inclusion in the Social Science Citation Index (ISI). Our application for accreditation in the DHET system was submitted in May and the results will be known by the end of the year.

Thank you to reviewers and authors who have, once again, offered their intellectual work to a journal that is waiting to be accredited. Should the submission by successful, we believe all the articles that are in the two issues this year will be eligible for subsidy.

Wishing you enjoyable reading.

Elizabeth Henning (Editor)
Graham Dampier, Hashina Ebrahim, Ronel Ferreira, and Shirley Pendlebury (Co-Editors)
July 2012
Ready or not: Kindergarten classroom engagement as an indicator of child school readiness

Abstract
Children’s preparedness for school is an important predictor of their eventual academic attainment, health, and personal success well into adulthood. Although kindergarten knowledge of numbers and vocabulary represent robust indicators of children’s readiness to learn at school entry, theory and research suggest that self-directed learning skills are also important in meeting the challenges of the elementary school classroom. This review examines evidence related to the potential benefits (e.g. improving children’s academic outcomes) of targeting classroom engagement skills, a person-environment fit characteristic reflecting task-orientation and industriousness. Reviewed studies suggest that classroom engagement skills are malleable and robust predictors of later elementary school achievement. Research also suggests that cognitive control skills in the form of executive functions are likely to underlie individual differences in classroom engagement. This paper provides evidence that developing pre-school and kindergarten curriculum that target cognitive control can be a useful strategy for enhancing student engagement behaviour. Developing early interventions that bolster school readiness can then help circumvent risks for later academic and social impairments in childhood and adolescence.

Keywords: school readiness; cognitive control; classroom engagement; learning-related behaviour; academic achievement; psycho-social adjustment.
Introduction

Making sure that the next generation of citizens, workers, and caregivers benefit from a basic education remains at the forefront of societal concerns. For example in Canada, the Québec Ministry of Education holds the mission of providing all children with the opportunity to acquire skills that will help them develop into contributing members of society (MELS, 2010). In addition to representing an important objective from a social policy standpoint, maximising the educational qualifications of each individual child also figures prominently on the economic agenda. Cost-benefit analysis research has highlighted the tremendous economic burden of underachievement and high-school dropout, which are as high as 34% among 17 year olds in the province of Québec, Canada (MELS, 2005). In light of aging population demographics, the province of Québec particularly depends on individual reinvestment in order to support social programmes for the next generation. In order to develop efficient intervention strategies aimed at improving high school completion, it remains important to identify modifiable child and family characteristics which can be targeted to bring about improvement in student achievement.

The importance of school readiness

The process leading to high school dropout originates early on in children’s academic trajectories. For instance, child characteristics in kindergarten forecast successful academic trajectories and persistence through high school completion (Entwisle, Alexander & Olson, 2005). One way to increase academic proficiency is to help children begin school fit for the challenges they will face throughout their educational journey. Indeed, there has been growing concern over the idea that children need to be well prepared at school entry in order to prevent them from falling behind (High & The Committee on Early Childhood, Adoption, and Dependent Care and Council on School Health, 2008; Tramontana, Hooper & Selzer, 1988; Zuckerman & Halfon, 2003). School readiness refers to child maturity and ability to negotiate classroom demands upon transitioning to formal schooling. A child that is ready to learn is capable of fully participating in the educational and social aspects of the kindergarten classroom. Theoretically, school readiness is a malleable outcome of early childhood life experiences and development (High & The Committee on Early Childhood, Adoption, and Dependent Care and Council on School Health, 2008). The promotion of school readiness has, therefore, become an important social preoccupation because of its potential for bettering the lives of individuals, communities, and society.

Interest and perspectives on school readiness have simultaneously emerged across academic disciplines. For economists, identifying which early capabilities predict achievement and employment potential represents an important investment from a human capital perspective (Duncan et al., 2007; Heckman, 2006; Murnane, Willett & Levy, 1995). Underachievement especially represents a costly social problem (Knudsen, Heckman, Cameron & Shonkoff, 2006). Medical practitioners have emphasised the importance of school readiness from a population health perspective,
drawing attention to the relationship between educational attainment and later health, morbidity, and mortality (Fiscella & Kitzman, 2009; Freudenberg & Ruglis, 2007). Furthermore, paediatric perspectives have proposed more integrative and contextual definitions of school readiness. That is, in addition to individual characteristics some have argued that schools and communities also need to be involved in supporting children through a successful transition (High & The Committee on Early Childhood, Adoption, and Dependent Care and Council on School Health, 2008; Zuckerman & Halfon, 2003). Finally, policy makers propose that international goals should include universal school readiness and proficiency upon school entry. Such reasoning is behind the highly publicised No child Left Behind act adopted in the United States of America.

Over the past half century, a lot of research has been allocated to identifying child characteristics that forecast success in early schooling (Duncan et al., 2007; Grissmer, Grimm, Aiyer, Murrah & Steele, 2010; Pagani, Fitzpatrick, Archambault & Janosz, 2010; Romano, Babchishin, Pagani & Kohen, 2010). The rationale for this focus is rooted in the notion that how one begins school predicts rewards or consequences for individuals, their families, and society at large. Research supports the claim that children who begin their academic journey on solid ground experience more academic success in primary school (Duncan et al., 2007). In contrast, children who experience difficulty early on are more likely to embark on a course of academic underachievement associated with an increased risk of dropping out of school (Alexander, Entwisle & Dauber, 1993; Alexander, Entwisle & Horsey, 1997). Youth who decide to drop-out of high school are then more likely to experience poorer health and engage in risky and antisocial behaviours including unprotected sexual intercourse, substance use and abuse, and involvement in criminal activity (Ellickson & McGuigan, 2000; Freudenberg & Ruglis, 2007; Hargreaves et al., 2008). Understanding what skills contribute to successful school experiences is therefore an important step for helping both children and their families achieve their maximum potential.

In a large scale international study of school readiness, Duncan et al. (2007) provide evidence that skills in math, reading, as well as attention, are important predictors of later academic achievement. Though previously hypothesised as important contributors to school adjustment (Ladd, Birch & Buhs, 1999), child classroom behaviours, such as aggression, prosocial skills, and anxiety, were not statistically significant. A major conclusion from these findings is that child behaviours carry less weight in facilitating academic success than early intellectual skills.

The findings of Duncan and colleagues have been replicated using a French Canadian sample (Pagani et al., 2010). Surprisingly, even though the replication presented methodological improvements over the original piece, a remarkable similarity in effect sizes was observed in both studies. Going beyond the Duncan et al. model, learning-related behaviours in terms of classroom engagement reflecting task-orientation and effortful control were addressed as additional outcomes. Kindergarten math and attention skills predicted second grade classroom engagement. This study did not address the origins of classroom engagement, as such the role of kindergarten
learning-related skills for school readiness has received less attention. In particular it would be interesting to examine if engaged kindergarten students fare better later in elementary school.

Even though knowledge of numbers and vocabulary explain a lot of the variance in achievement (Duncan et al., 2007), they leave out a theoretically meaningful self-determining component. In order to be successful in the classroom, children also need to develop strong learning skills and remain engaged in the classroom if they are to fully benefit from instruction and learning experiences (Bierman et al., 2008; Fredricks, Blumenfeld & Paris, 2004). Recently, the importance of engagement reflecting commitment and persistence toward learning and academic goals has received attention as a promising target for interventions aimed at reducing student dropout and poor academic achievement (Fredricks et al., 2004; Janosz, Archambault, Morizot & Pagani, 2008). A chief benefit of studying engagement resides in the intuitively appealing notion that engagement is directly related to learning, as well as in the idea that engagement, unlike IQ or family socio-demographics, is malleable and amenable to change (Fredricks et al., 2004). Moreover, an interest in child learning behaviour is also consistent with many educational reform policies. The acquisition of reading, writing, and mathematics skills remain key domains of child performance. However, the ability to get along and cooperate with fellow students, follow rules and instructions, and work autonomously has been integrated within the grading schemes used to evaluate performance of elementary school students.

In the present review, we propose a model of school readiness that addresses the unique contribution of self-directed learning behaviour to children's academic potential. In particular, we examine how classroom engagement behaviour reflecting the ability to follow procedures, remain on-task, and adapt to the demands of the classroom plays a role in setting the course for successful academic trajectories. We also examine how early life experiences contribute to school entry classroom engagement, and subsequent patterns of engagement across elementary school.

**Definitional issues**

Though the concept of engagement has been defined and operationalized in a number of ways in the education literature, commonalities across studies include a definition of engagement as a reflection of the person-environment fit (Fredricks et al., 2004). In this light, an individual’s ability to benefit from instruction and be successful in school may dependent not only on how much they know at school entry, but also on their mastery of skills that favour adaption to the norms and demands of the classroom. For example, children who demonstrate self-directed behaviour that favours learning and involvement in the classroom are likely to be more successful and illicit more positive reactions from teachers (Pianta, 2009). Children with these favourable characteristics are likely to be rewarded for their behaviour by teachers, which can further reinforce positive classroom behaviour in the future (Skinner & Belmont, 1993). From a contextual or systemic approach, changes in engagement are likely to arise through
interventions that target relevant characteristics of the child, their environment, or both.

One recent empirically driven conceptualisation from educational science has been useful in advancing our understanding of the nature and potential usefulness of engagement as an indicator of school readiness. Based on a thorough review of the education literature, Fredericks et al., (2004) conclude that engagement is a multifaceted concept with emotional, cognitive, and behavioural components. As a result, this definition helps organise a wide range of behaviours, which, if targeted, can improve academic performance. Furthermore, this distinction can guide the development of more refined risk profiles for detecting children who may be facing poor academic achievement and dropout. When broken down into affective, behavioural and cognitive components, high school engagement trajectories are reliable predictors of high school student’s eventual attainment and high school completion (Archambault, Janosz, Fallu & Pagani, 2009; Janosz et al., 2008).

Although Frederick’s rigorous review of the literature has highlighted the potential usefulness of adopting a multi-faceted conceptualisation of engagement, a more behavioural measure of engagement is useful for examining this trait in elementary school students. First, it provides a distal but ecologically meaningful demonstration of self-regulation that can be easily observed by kindergarten teachers. Second, behavioural engagement, such as being on-task, also presupposes a certain amount of cognitive and emotional engagement. Poor control of emotions and the inability to effectively direct attentional resources to classroom tasks are disruptive to on-task behaviour (Rothbart & Bates, 2006). Third, a focus on behavioural engagement is more appropriate given the developmental stage of elementary school children. Most of the work which has examined affective and cognitive engagement was conducted with older elementary and high school students. As a result, affective and cognitive engagement defined in terms of child attachment to the school, participation in extra-curricular activities, and preference for enriched classes and exercises may not represent meaningful indicators of engagement in young elementary school students. Finally, the present focus on behavioural engagement is consistent with sociological theories of individual success. Positive work-habits and the willingness to conform to rules and instructions in the childhood learning context are important because they are akin to the skills required for success in the adult workplace. For example, a review of literature in sociology, conducted by Farkas (2003), suggests that adults who possess a combination of learning skills that reflect respect for authority, initiative, task-orientation as well as the ability to follow rules and procedures experience greater occupational and personal success. These findings are consistent with the current conceptualisation of classroom engagement.
Theoretical perspectives on school readiness and classroom engagement

School readiness

In retrospect, research on school readiness has been driven by the immediate needs of social policy more so than carefully constructed theory. This may be due to the demand placed on policy makers to increase the overall quality of education to solve urgent social problems. Nevertheless, there are several theoretical and empirical considerations that should be taken into account in methodological and conceptual approaches to school readiness.

School entry coincides with an important transition in children’s cognitive development. According to Piaget (1956), an important cognitive shift occurs around the age of six, which serves as the basis for complex thinking and cognitive processing. One implication of Piaget’s stage-driven theory of development is that only cognitively mature children will be able to acquire classroom lessons demanding more complex mental operations. Conversely, less cognitively mature children may experience difficulty in school. Cognitive neuroscience research also suggests that important stage-like changes in child cognition emerge during the pre-school period (Feldman, 2009; Marcovitch & Zelazo, 2009; Zelazo & Frye, 1998). For instance, in response to rapid brain development during the first years of life, children become much more proficient at using focused attention and working memory to solve problems (Feldman, 2009; Garon, Bryson & Smith, 2008; Marcovitch & Zelazo, 2009). These improvements in attention and working memory in early childhood forecast children’s subsequent use of inhibitory control, which emerges later in the pre-school years (Feldman, 2009). Consequently, by school entry children are generally capable of exercising effortful control over behaviour and delayed gratification in the pursuit of goals (Mischel, Shoda & Rodriguez, 1989).

According to neurocognitive theories, a window of relative plasticity is also likely to help children more easily acquire new behaviour, knowledge, and skills during early childhood. The remarkable success of carefully designed pre-school interventions programmes supports the existence of a developmentally sensitive period for learning (Diamond, Barnett, Thomas & Munro, 2007; Gormley, Phillips & Gayer, 2008; Heckman, 2006). Although theories of plasticity do not suggest that new learning cannot occur outside of this period, they do suggest that a stronger environmental push may be needed outside of this timeframe to bring about improvement in children’s cognitive and social skills. Because interventions that occur later in childhood and adolescence usually require more resources, they are viewed as less cost-effective (Heckman, 2006; Knudsen et al., 2006).

Classroom engagement

Concepts across several theoretical perspectives are relevant to the proposed definition of classroom engagement. For one, classroom engagement falls into the
broad category of self-regulation processes, which encapsulate the combination of cognitive and emotional strategies individuals use to influence their own internal states, thoughts, and behaviours (Rothbart & Bates, 2006). Self-regulation is likely to support classroom engagement behaviour by facilitating self-initiated responses, such as those that require effortful control, delay of gratification, self-control, and self-discipline. The present definition of classroom engagement also bares similarity to motivational concepts described in Deci & Ryan’s self-determination theory (2008). In particular, classroom engagement is likely to partially reflect identified motivation, which refers to the capacity to remain on-task and perform deliberate, effortful, and challenging exercises, even in the absence of pleasure or enjoyment.

Blair and Diamond (2008), describe school entry competence as the result of multiple interacting child and family level systems (e.g. gene expression, parenting, cultural norms, etc.). These interrelations are described as interacting and dynamic because similar risk factors are likely to give rise to different outcomes according to their context. For example, Blair and Diamond make excellent reference to the case of the catechol-O-methyltransferase [COMT] gene whose common expression is associated with better cognitive control and executive functioning. In particular, this gene tends to result in higher levels of dopamine in the prefrontal cortex. Approximately 25% of individuals possess a variant of this gene, which leads to faster clearing of dopamine in the prefrontal cortex. This genotype is associated with poorer performance on cognitive control tasks. However, more dopamine in the prefrontal cortex also makes individuals more responsive to stress. As a result, individuals who possess the variant of this gene, resulting in lower levels of dopamine in the prefrontal cortex, are expected to perform better on cognitive tasks under conditions of moderate stress. By contrast, this scenario is reversed for the majority of children under non stressful conditions (Blair & Diamond, 2008).

Blair and Diamond’s model also helps clarify a mechanism through which emotional and cognitive dimensions of self-regulation can mutually influence each other and ultimately classroom behaviour. Cognitive control, or executive functions consists of the inhibition of inappropriate responses, working memory ability, and attentional control (Garon et al., 2008; Miyake et al., 2000). These skills, which are governed by the prefrontal cortex, play an important role in sustaining children’s goal directed behaviour in the classroom (Barkley, 1997; Blair & Diamond, 2008). To be successful in the classroom, children must inhibit unfavourable behaviours, use working memory to solve problems and answer questions, and exercise control over attention, in order to remain responsive to changing instructions and contextual constraints. Emotional regulation, in turn, represents the ability to modify the experience of emotions to meet contextual demands. These skills, which involve regulating one’s own states and exercising wilful control over behaviour, can also help support engagement in the classroom. This means that cognitive control skills may both influence emotional outcomes, as when children inhibit feelings of frustration, and be influenced by them, as when anxiety impairs concentration. For young students, the ability to optimise arousal and positive affect, much like reducing negative emotions, is also likely to
improve academic performance. For example, mild levels of test anxiety have been shown to benefit cognitive performance (Lupien, Maheu, Tu, Fiocco & Schramek, 2007).

Preschooler cognitive control skills have been linked to academic achievement and psychosocial function in later childhood. Foremost is the link between executive function and math performance (Blair & Razza, 2007; Bull & Scerif, 2001; Butterworth, Varma & Laurillard, 2011; Cirino, 2010; Sabbagh, Xu, Carlson, Moses & Lee, 2006). Other research suggests a strong link between cognitive control and writing skills (Altemeier, Abbott & Berninger, 2008; Altemeier, Jones, Abbott & Berninger, 2006). Furthermore, pre-school children who are better able to exert effortful control to delay gratification score higher on cognitive achievement tests several years later in adolescence (Mischel et al., 1989).

Children who are experiencing difficulty in the area of cognitive self-regulation are also at risk of facing impairments in psychosocial and interpersonal domains. Eisenberg and colleagues (2001) have shown that four- to eight-year-old children who experience difficulties in effortful control are more likely to display internalising and externalising problems in later childhood. Similarly, children who display unstable or low levels of cognitive control (i.e. the ability to resist distractions and temptations) between the ages of five and 10 subsequently show more elevated trajectories of externalising problems (Zhou et al., 2007). Finally, children who demonstrate low levels of effortful control self-report more delinquency and convictions by age 21 (Henry, Caspi, Moffitt, Harrington & Silva, 1999).

Research, employing a person-centered approach, suggests that school-aged children diagnosed with ADHD are more likely to show multiple impairments in academic, social, behavioural, and emotional domains (Lee, Lahey, Owens & Hinshaw, 2008). This is not surprising given that poor cognitive control represents a central impairment in ADHD (Barkley, 1997). Furthermore, in a sample of adolescents, ADHD symptoms were associated with impairments in expressive, receptive, and written communication ability, as well reductions in the ability to engage in social interactions, be responsible, and show sensitivity towards others (Clark, Prior & Kinsella, 2002).

Classic developmental theories also suggest an important role for classroom engagement in positive child adjustment. According to Russian developmental psychologist Lev Vygotsky (1987), the ability to self-regulate and remain engaged, depends on children’s ability to master and eventually internalise speech. More specifically, the development of childhood self-control skills involves a developmental progression from the use of ‘outloud’, non-specific language, to the use of ‘private’, internalised language, to guide goal-directed behaviour (Vygotsky, 1987). This process is believed to occur within an ‘open system’, which suggests interactions with the environment can facilitate children’s acquisition of private speech and eventually self-control (Cicchetti, 1984). Once children are capable of internalising speech, they can more efficiently use language to give themselves instructions during the performance of complex problems. They may also find it easier to persist in the face of distractions,
regulate emotional responses, and inhibit inappropriate behaviours in the classroom. Research on child temperament also supports the idea self-regulation develops in part through fruitful interactions with caretakers (Rothbart & Bates, 2006).

The American sociologist Erik Erikson’s notion of industriousness, which refers to children’s ability to learn skills required for participation in adult society, is also consistent with the present conceptualisation of engagement. According to Erikson’s theory of identity development (1950), the period from age 6 to 11 is characterised by environmental and social demands placed on the child to develop strong work habits and industriousness. Some children may fail to meet the social demands of the classroom because they lack the requisite skills to regulate their cognitions and emotions. These children, in turn, may be at risk of experiencing poor achievement and feelings of inadequacy or inferiority, which may manifest themselves as psychosocial adjustment problems later in life. In line with this view, others have argued that children who experience difficulty adjusting to the demands of the kindergarten classroom are likely to develop perceptions of themselves as being incompetent, which can undermine future academic adjustment and motivation (Blair & Diamond, 2008; Deci & Ryan, 2008). Evidence supports this hypothesis as early school failure that results in grade retention is associated with persistent academic and psychosocial problems toward emerging adolescence (Pagani, Tremblay, Vitaro, Boulerice & McDuff, 2001).

Finally, it is interesting to note that child engagement is related to American criminologists Gottfredson and Hirshi’s notion of self-control and social bonds (1990). According to social control theory, children who are engaged in school, and willing to invest time and effort in completing their work and attaining good grades, are unlikely to become involved in delinquent behaviours. By contrast, poor attachments and bonds with others, such as peers and teachers, and reduced involvement with conventional institutions, such as schools, are believed to erode individual self-control. Low self-control, in turn, is believed to mediate future involvement in antisocial and deviant behaviour (Moffitt & Henry, 1989; Wright, Caspi, Moffitt & Silva, 1999). In this sense, classroom engagement can be interpreted as an index of children’s capacity to integrate and conform to the social norms and values of society.

In summary, converging theory and research suggest that productive learning behaviours represent important indicators of children’s academic potential. Definitions of engagement have been useful in clarifying the range of behaviours that can be measured as indicators of engagement (Fredricks et al., 2004). Finally, Blair and Diamond’s developmental model has enhanced our understanding of the potential dynamic interplay of emotional and cognitive processes in children’s regulation of classroom engagement.

**Expanding Duncan’s school readiness model**

Because of its large sample size and methodological rigor, Duncan and colleagues’ (2007) model of school readiness has become a benchmark in school readiness
research. Despite its empirical usefulness it does present three important limitations. First, a general finding of research using this model is that kindergarten entry behaviours, with the exception of attention problems, are not predictive of later success. This conclusion should be interpreted with caution, since the authors only assessed a restricted range of mostly negative or problematic child behaviours. It would have been equally, if not more, informative to examine productive learning-related skills, such as classroom engagement as opposed to child internalising (i.e. anxiety) and externalising (i.e. physical aggression) problems. A second limitation of Duncan’s model is that only academic success was considered as a pertinent outcome of interest. However, it is plausible that school readiness forecasts future adjustment in multiple spheres of child functioning. Furthermore, children need to develop a variety of competencies, including positive psychosocial skills and strong work habits on the road to high school completion and successful transition to adulthood. For these reasons it is useful to consider a holistic set of child functioning indicators as outcomes of school readiness. A third limitation of Duncan’s model is that it does not help us understand the origins of children’s successful adjustment to school. Understanding this developmental chain of events is essential to maximise pre-school intervention and prevention strategies.

Re-evaluating and expanding definitions of school readiness can help us better identify children at risk of future academic problems. Reliable school readiness models can also be used in the development of head start programmes for pre-schoolers. Thus, to achieve universal school proficiency starting in the first grade, it is important to ensure that our definition of school readiness encompasses a comprehensive range of skills that support child learning and adaptive psychosocial functioning across development.

**Classroom engagement and achievement**

Classroom engagement incorporates elements of task-orientation, attentiveness, cognitive control, and behavioural regulation. Accumulating evidence suggests these skills can reliably predict later academic performance (McClelland, Acock & Morrison, 2006; McWayne, Fantuzzo & McDermott, 2004; Pagani et al., 2008). In the following section we review evidence supporting an association between kindergarten classroom engagement skills and achievement in later elementary school.

Using a sample of 200 pre-schoolers enrolled in a Head Start programme, McWayne and colleagues examined which child skills were predictive of later achievement (2004). At around the age of five, children completed several scales to assess their preparedness for kindergarten learning. These included measures of pre-academic skills in terms of literacy and numeracy, motor development, quality of peer interactions and learning-related behaviours reflecting attention and persistence, motivation and competence, and attitudes towards learning. The following year, children completed the Early Screening Inventory designed to detect children at risk for developmental and academic problems. Results revealed that pre-academic
skills and learning-related behaviours were the only significant predictors of later achievement. These associations were observed above and beyond the quality of children’s Head Start classroom and neighbourhood characteristics.

In another study, authors examined whether kindergarten learning behaviour predicted individual patterns of academic achievement across the elementary school years. Using a large sample of children followed longitudinally from kindergarten through Grade 5, Li-Grining and colleagues (2010) found that child learning skills reflecting task-orientation, autonomy, and attentiveness were associated with later achievement trajectories across the elementary school years. Furthermore, this association did not differ between children on the basis of socio-economic status and ethnicity. McClelland and colleagues (2006) also examined how learning skills predicted achievement across elementary school. The authors found that kindergarten students who showed higher levels of productive work habits, achieved more academic success in Grades 1 through 6. More engaged children also showed steeper increases in academic achievement in the early elementary school years. The achievement gap between children with higher and lower levels of kindergarten engagement appeared to remain rather stable until the end of elementary school. Furthermore, the association between learning behaviour and patterns of engagement was observed above and beyond the potentially confounding influence of child IQ, ethnicity, and maternal education. Finally, in a study which followed children from the ages of five through to the age to 13, Ladd and Dinella (2009) observed that compared to children who showed active participation and engagement in the classroom, children who were more resistant to following instructions were more likely to show maladaptive patterns of achievement during the transition to secondary education.

Other research also suggests a strong role for learning-related behaviour in academic success. First grade students who participate and are more involved in the classroom tend to do better on fourth grade academic measures (Alexander et al., 1993). Kindergarten task-orientation and persistence have been shown to explain the relationship between early aggressive and prosocial behaviours and first grade math and reading achievement (Normandeau & Guay, 1998). Duncan et al., (2007) found that teacher-ratings of poor attention control represent key components of school readiness that reliably forecasts later academic success above and beyond a large set of child and family characteristics. Teacher-ratings of attention problems can also explain unexpected trajectories of academic failure (Pagani et al., 2008). Finally, later on in adolescence, student self-control explains the gender gap in achievement (Duckworth & Seligman, 2005).

In sum, several studies have defined learning-behaviours as encompassing components of classroom engagement such as autonomy and self-regulation. Studies have tended to show that these productive work behaviours measured as early as kindergarten, are associated with achievement outcomes in later elementary schools. These predictive relationships appear to be robust and can be observed above and beyond potentially confounding child and family demographic characteristics.
Academic performance: Is achievement all that matters?

Achievement outcomes have represented a singular focus in much of the school readiness literature. This is surprising from both a theoretical and practical perspective. For one, in addition to forecasting academic outcomes, kindergarten classroom engagement skills are also likely to predict adaptive psychosocial functioning in later childhood. Furthermore, from a pragmatic perspective, the omission of psychosocial outcomes in school readiness research is unfortunately given that social and interpersonal skills are key ingredients for success throughout schooling and eventually in the labour market (Almlund, Duckworth, Heckman & Kautz, 2011; Heckman, 2007).

Empirical research has shown that children who show poor engagement in the classroom are likely to develop more conflictual relations with teachers and peers. Poorly regulated disruptive children are also more likely to undermine group functioning, experience social rejection, and develop poor academic motivation (Ladd, Birch & Buhs, 1999; Chen, Huang, Chang, Wang & Li, 2010; Vitaro, Brendgen, Larose & Tremblay, 2005). By contrast, the cognitive control skills that underlie children’s ability to remain engaged in the classroom are likely to contribute to positive psychosocial adjustment. Children’s ability to control attention can contribute to the successful inhibition of inappropriate emotional responses. In particular, better cognitive control can help children direct attention away from negative emotions (Rothbart & Bates, 2006). On the other hand, temperamental dispositions towards emotional reactivity can compromise the quality of children’s social interactions. For example, it can interfere with child ability to effectively focus and shift attention to appropriate social cues during social exchanges. The ability to cooperate with other children to complete classroom activities is a key determinant of children’s academic adjustment. Failure to mobilise attention towards decoding the states of others is likely to lead to interpersonal conflict, peer rejection, and academic adjustment problems.

Examining children’s holistic development also makes sense for practical reasons. Children need to develop a variety of competencies, including positive psychosocial skills and strong work habits, on the road to high school completion and the successful transition to adulthood. Non-cognitive or social skills, not typically measured by ratings of achievement, remain important predictors of how children will fare in their future personal and professional relationships. In the workplace, adults who develop more positive interpersonal orientations are likely to achieve more occupational success, even once their cognitive ability is taken into account (Almlund et al., 2011; Farkas, 2003; Heckman, 2007). As a result, to benefit societal investment, a public educational system should help students prepare for their future roles as citizens, workers, parents, and health-care users. In light of this, the usefulness of a school readiness model could benefit from its ability to predict positive psychosocial skills in addition to academic achievement in math and reading.

There is some preliminary evidence that children who have difficulty remaining engaged in kindergarten are more likely to experience a wide range of adjustment
problems by the end of elementary school (Fitzpatrick, 2012). In a representative population-based sample, one study examined the association between kindergarten classroom engagement skills and a wide range of child academic and psychosocial adjustment indicators by the end of elementary school. Kindergarten students who were rated by teachers as more engaged as defined by the tendency to work autonomously, follow directions, and remain attentive showed higher levels of academic achievement, had more positive relations with teachers, and showed less symptoms of problematic aggressive and antisocial behaviour by the fourth grade. Associations remained significant after controlling for kindergarten literacy and math skills and symptoms of behaviour problems. Furthermore, these results did not differ on the basis of gender or family background characteristics.

Early predictors of classroom engagement
To date, few studies have empirically addressed the developmental origins of classroom engagement (Shonkoff & Phillips, 2000). Given the importance of cognitive control and early attention control in the pursuit of goal-directed behaviour (Barkley, 1997; Rothbart & Bates, 2006), it is likely that early childhood cognitive development forecasts school entry engagement. One possibility is that heterotypic continuity exists in cognitive control ability from the early pre-school years to age five, whereby early cognitive control skills culminate in better classroom engagement at school entry (Putnam, Rothbart & Gartstein, 2008). From an intervention perspective, better understanding this developmental chain remains an important goal for enhancing school readiness in at-risk children.

Furthermore, as suggested by ecological and transactional theories of child development (Blair & Diamond, 2008; Bronfenbrenner, 1986; Rothbart & Bates, 2006; Vygotsky, 1987), it is likely that the development of cognitive control is influenced by children’s early environment and experience with caretakers. In particular, supportive parenting that is aimed at helping children sustain attention during activities is likely to help children develop strong attention control skills (Belsky, Pasco Fearon & Bell, 2007; Razza, Martin & Brooks-Gunn, 2010). Research on individual differences in temperament also suggest that while genetic differences exist in attention from infancy onward, early parent child interactions also play a role in helping children develop sustained attention (Rothbart & Bates, 2006). Additional family characteristics, such as maternal stress and social support, might also influence the development of positive learning-related behaviour at school entry (Razza et al., 2010). High levels of maternal stress are related to an increased incidence of attention problems in middle childhood (Barry, Dunlap, Cotten, Lochman & Wells, 2005). As a result, it would be informative to examine whether mothers’ experience of stress and social support during the pre-school years are associated with poor classroom engagement skills in children during elementary school.

Research provides some evidence that cognitive control skills represent developmental precursors to classroom engagement behaviour in elementary school.
For example, Mathews and colleagues (2009), found that child behavioural self-regulation skills at age five predicted early academic performance. In another study by Blair and Razza (2007), pre-school self-regulation skills in the form of effortful cognitive and attention control predicted school entry competence in math and reading. In another study, authors examined whether cognitive control skills in children as young as 3 could predict school readiness. After controlling for the potentially confounding effect of socio-economic status and child intellectual ability, working memory skills predicted unique variance in kindergarten classroom engagement, number knowledge, and receptive vocabulary skills (Fitzpatrick & Pagani, 2011). Another study examined how sustained attention skills and parental factors at age three contribute to kindergarten school readiness. In both poor and near poor children, better sustained attention and lower impulsivity predicted receptive vocabulary scores at school entry. The only parental characteristic associated with later verbal skills was maternal hostility. Similar results were obtained by Fitzpatrick (2012). In this study, patterns of child engagement across elementary school were predicted from toddler working memory skills and lower levels of impulsivity. Furthermore, similar to what was found by Razza et al., maternal hostility was the parental characteristics most strongly associated with child eventual adjustment to school. Finally, in line with ecological models of development, mothers’ experience of stress, and perceptions of social support also predicted children’s learning trajectories across elementary school.

Discussion

Children’s ability to follow directions, work autonomously, and remain focused in the classroom setting represent useful indicators of their preparedness to meet the demands of formal schooling which begins in the first grade. In particular, literature suggests that classroom engagement skills are related to later achievement in mathematics and reading several years later (Daniels et al., 2008; Fitzpatrick, 2012; Ladd & Dinella, 2009; McClelland et al., 2006; McWayne et al., 2004). Engagement skills may be related to these later outcomes, because they facilitate adaptation to the academic and social demands of the early school environment. They are also likely to reflect underlying individual differences in self-regulation skills, which play an important role in helping individuals adjust to novel challenges.

Poor engagement is also related to indicators of child psychosocial adjustment. For one, it predicts more conflict with teachers. Children who were less engaged in the classroom also appeared to use more aggressive and antisocial behaviour while interacting with fellow students (Fitzpatrick, 2012; Ladd et al., 1999; Razza, Martin & Brooks-Gunn, 2010). The quality of relationship students develop with grade school teachers can have important repercussions on children’s subsequent academic trajectories. Teachers may be less inclined to exert effort and provide guidance to challenging students. Furthermore, elementary school teachers in particular, spend a lot of time with the same children for whom they play a role as both a nurturer and
educator. As a result, teacher’s expressions of warmth/closeness or anger/conflict over the course of a school year can shape children’s school and learning experience. In particular, much like good parenting skills, teacher warmth and structure are likely to enhance child outcomes; whereas conflictual relations with teachers are likely to steer children toward less positive learning trajectories (Baker, 2006; Brendgen, Wanner & Vitaro, 2006; Hamre & Pianta, 2001; Rimm-Kaufman, La Paro, Downer & Pianta, 2005). Once established, teacher expectations of their students can then influence later student achievement, even when past performance is taken into account (Rosenthal & Jacobson, 1968).

An association between classroom and psychological adjustment, from a prevention perspective, is of concern. Elementary school students who perpetrate proactive acts of aggression are at an elevated risk of following a course characterised by involvement in later criminal and antisocial behaviour (Nagin & Tremblay, 1999). Furthermore, children who present externalising problems are more likely to be excluded from their peer group (Ladd et al., 1999; Vitaro et al., 2005). Disruptive children are also more likely to experience rejection or victimization, especially if the larger social group labels them as ‘unpopular’. By contrast, children who show lower levels of behavioural problems are likely to develop more supportive relations with peers. These children are then more likely to be included in classroom activities, which can increase positive feelings towards school and access to social and academic learning opportunities.

Overall, the evidence reviewed regarding the value of classroom engagement is useful for several reasons. Academic achievement tends to stabilise in the middle of elementary school. Youth who are experiencing difficulty in primary school are therefore more likely to follow a path leading to underachievement and high school dropout (Alexander et al., 1993). Dropping out of high school is subsequently associated with a cascade of risks that can impede wellbeing throughout the life course. For example, the decision to drop-out of high school increases the risk of lifelong poverty (Card, 1999), poorer health (Freudenberg & Ruglis, 2007), and antisocial life-course trajectories (Henry et al., 1999). Consequently kindergarten measures that forecast achievement in the fourth grade represent useful tools for identifying children at risk of lifelong adjustment problems.

There is also evidence that early childhood cognitive control is a robust predictor of engagement in elementary school. These findings suggest that early interventions that strengthen attention control and working memory, two important mechanisms of learning, can significantly improve school readiness. Furthermore, some research suggests that parental characteristics can influence childhood engagement trajectories (Razza et al., 2010; Fitzpatrick, Barnett & Pagani, unpublished data). These observed associations relating the larger family ecology to child learning outcomes suggest the importance of providing support to at risk-families in order to reduce academic underachievement.
The findings of the present review can be interpreted within a larger self-regulation framework. According to developmental theories, an individuals’ capacity to effectively manage their inner states and cognitions plays an important role in helping them meet the demands of their social and work environments (Barkley, 2004; Rothbart & Bates, 2006). Though children’s development of self-regulation is partially due to maturation, early environments and experiences with caregivers can also shape its course (Bernier, Carlson & Whipple, 2010; Shonkoff & Phillips, 2000). Given the notion of heterotypic continuity, early individual differences in attention control and temperament are likely to manifest themselves as greater task-orientation and classroom engagement by the time children enter school (Putnam et al., 2008; Rothbart & Bates, 2006). Furthermore, initial differences in cognitive control can help children develop the ability to mobilise attention in the service of emotional regulation, which in turn can be beneficial for sustaining concentration in stressful or frustrating situations. Better emotional regulation can also facilitate positive social interactions (Rothbart & Bates, 2006). From a developmental perspective, early failures and successes are also likely to influence children’s beliefs about their level of competence, which can then have an impact on their motivation to succeed (Deci & Ryan, 2008). In particular, early difficulty with engagement and academic performance may undermine child motivation, which can then predispose children to embark on stable low trajectories of classroom engagement. The possibility of such a feedback loop strongly suggests the importance that making sure children are ready to learn at school entry for the prevention of well-being and academic problems.

Implications

Curriculum and classroom engagement

Historically, schooling policies have functioned primarily to ensure a steady inflow of workers to fuel the labour market (Lillard, 2005). For efficiency purposes, children were asked to assimilate large amounts of knowledge passively from teachers. In this context, little emphasis has been placed on problem-solving, creativity and autonomous learning. Classrooms, teaching styles, and curricula were standardised with a one size fits all formula. While this form of classroom arrangement is well suited for its intended purpose of developing workers for the industrial market, social and technological transformations over the past century have changed the nature of working conditions. For this reason, the ‘factory model’ of learning can be seen as increasingly ill-suited for current market characteristics, which favour workers that are skilled learners capable of flexible problems-solving skills (Knudsen, Heckman, Cameron & Shonkoff, 2006). Traditional kindergarten classrooms are likely to be especially inefficient for the promotion of flexible learning and classroom engagement in young children during a developmental period that favours creativity.

Interventions and curricula that target pre-school children represent promising avenues for increasing school readiness and adjustment throughout childhood.
Few programmes, to date, have been designed to specifically improve cognitive control and classroom engagement in pre-school aged children. Nonetheless, *Tools of the Mind* pre-school programme (Bodrova & Leong, 2007), Montessori Education (Lillard & Else-Quest, 2006), and the REDI programme (Bierman, Domitrovich et al., 2008; Bierman, Nix, Greenberg, Blair & Domitrovich, 2008) have been designed to improve child cognitive control and classroom learning behaviour. Other programmes have included child self-regulation components within larger objectives (e.g. Webster-Stratton, 2001). Finally, several programmes have addressed specific cognitive control skills over short periods of time (Klingberg, Forssberg & Westerberg, 2002; Rueda, Rothbart, McCandliss, Saccomanno & Posner, 2005). In the following sections these programmes will be reviewed in order to identify the most promising interventions for enhancing student’s classroom engagement.

**Tools of the mind**

According to Lev Vygotsky’s social learning theory, children’s acquisition of new skills occurs most efficiently in the context of social interactions. Specifically, social interactions are seen as facilitating learning through a process referred to as scaffolding. This process involves a more experienced teacher facilitating child acquisition of knowledge by providing graded assistance to children within the “zone of proximal development”. As previously discussed, an important outcome of social learning is children’s development of self-regulation. For example, through meaningful interactions with caretakers children become increasingly skilled at using private speech to guide their behaviour. The ability to give oneself instructions in order to plan and regulate one’s actions is especially important for the accomplishment of self-controlled behaviour.

The *Tools of the Mind* programme was developed by educational psychologists Bodrova and Leong (1996) and was inspired by Vygotsky’s theory of development (1987). The objective of this programme is to improve cognitive control in the form of self-regulation, metacognition, cognitive flexibility, and working memory in children with the aim of facilitating goal-directed planning, problem solving, and learning. An important component of this programme involves teacher scaffolding and children’s use of speech, or constructive self-talk, to facilitate cognitive control (Bodrova & Leong, 2007). For example, teachers can help children develop metacognition or “thinking about thinking” by prompting children to share how they solved a problem or why they chose one course of action over another. Children also develop self-regulation skills by engaging in activities with peers. For example, in one game, one child plays the role of the ‘checker’ whose role is to monitor (out loud) the work of their partner as they attempt to complete a task. As children become increasingly skilled at monitoring the work of others, teachers can modify the task by asking children to switch from monitoring the work of others to monitoring their own work during a problem solving task. This exercise is designed to help children learn how to internalise speech and language to regulate their own behaviour.
Children also work on inhibitory control, by participating in a game called Graphics Practice. During this game, children draw different kinds of marks while music is played. They must then stop on a determined cue. Finally, children also develop working memory and cognitive control by engaging in dramatic play. For example, during dramatic play, children are asked to play a role, thus requiring them to update and keep in working memory information that is relevant to their scenario. Furthermore, as children interact with others, they must also use attention control and flexibility in order to help them adapt and rethink their role in light of new developments.

The effectiveness of Tools has been demonstrated with four-year-olds from disadvantaged neighbourhoods (Diamond, Barnett, Thomas & Munro, 2007). Specifically, when compared to controls, children randomly assigned to follow Tools curriculum performed better on executive function tests one year later. Unfortunately, there are no data available on the effectiveness of this programme from non-disadvantaged children. As such, in order to better understand the potential benefit of implementing this programme on a wider scale, replications with more heterogeneous population-based samples are necessary. Nevertheless, this programme remains promising in light of its effectiveness and ease of implementation within the preschool environment.

**Montessori education**

Montessori educational systems were designed to target social and academic skills in children from disadvantaged backgrounds (Lillard, 2005). An evaluation of this programme suggests its effectiveness in promoting cognitive control, moral development, and learning skills. Characteristics of this programme include mixed-aged classrooms, student-directed learning activities, and long periods of uninterrupted play (Bodrova & Leong, 2007). As in Tools of the Mind, children in Montessori classrooms spend much of their time engaged in self-directed learning activities which require autonomy, creativity, and self-control. These effortful control skills represent important foundations for the development of strong classroom engagement skills.

The effectiveness of this system has been measured by comparing two groups of pre-school aged children who were, or were not, granted access to a Montessori classroom through a random lottery. Though all the participants self-selected themselves for Montessori education, the randomised lottery suggests that differences between these groups reflect differences in the education they received during one year of pre-school. Results of the evaluation indicate that relative to controls, Montessori children scored higher on math problem-solving and phonological awareness by the end of kindergarten (Lillard & Else-Quest, 2006). In addition, Montessori five-year-olds scored higher on tests of executive functioning and moral reasoning and were less likely to show aggressive behaviour.
REDI pre-school intervention programme

The REDI programme involves research-based curricula and instructional strategies which were developed with the specific aim of improving children's cognitive control skills. The contents of this programme have been integrated within larger school readiness interventions, such as Head Start (Bierman et al., 2008). The objective is for children to improve their self-regulatory skills in terms of cognitive and emotional control by listening to stories, playing with puppets, and role playing in the classroom. In addition, teachers are provided with training sessions and supervision to help them develop positive classroom management skills, appropriate praise, warm involvement, emotional coaching, and problem-solving dialogue.

Two randomised controlled studies indicate that the present programme implemented in the classroom setting can increase children’s working memory, inhibitory control, and attentional set-shifting (Bierman et al., 2008; Bierman et al., 2008). Furthermore, children who participated in this programme also showed improvements in learning engagement. As in the other interventions, a weakness of the original version of the REDI programme is the absence of a parental component. However, in order to increase the dosage of this programme, an enriched version that includes a parental component, has been developed and has demonstrated favourable results (Bierman et al., 2008).

The Incredible Years programme

The goal of this programme is to reduce conduct problems in children. This intervention was not directly concerned with the improvement of children’s cognitive control skills. However, the Incredible Years does include modules that target productive classroom behaviour (Webster-Stratton, Jamila Reid & Stoolmiller, 2008).

Both teachers and parents deliver the child component of this programme. Guidance is provided to teachers and parents through training videos, manuals and participation in discussion groups. The child component is administered via multiple mediums including videos, selected readings, collaborative learning exercises, games, and the completion of supervised homework exercises. Learning-related skills are targeted by teachers who encourage students to listen and raise their hand in class. Teachers also help students develop good concentration skills by showing them how to avoid interference in the classroom and by teaching them to take time to check over their work.

Parents help transmit the curriculum by learning positive discipline skills. By learning productive parenting strategies, parents are better able to monitor, set limits, establish learning routines, and avoid using criticism. These skills are believed to help children develop better self-regulatory skills and classroom competence. The benefit of including a parental component is supported by research (Razza et al., 2010). In particular hostile parenting has been associated with lower levels of classroom engagement in elementary school.
The strengths of the present programme include its inclusion and integration of child, parent, and teacher components and its thoughtfully designed training materials, which can be adapted to individuals from different cultural contexts. Randomised control group studies have demonstrated the effectiveness of The Incredible Years programme (Webster-Stratton et al., 2008). Participation is associated with reductions in teacher-rated problem behaviours and increased academic achievement in at-risk children. What remains to be examined is whether parental and teacher training in positive discipline strategies enhances the effectiveness of pre-school programmes designed to improve classroom engagement skills.

Additional programmes

Though the following programmes are small in scope, they describe training interventions that are likely to help strengthen children’s ability to sustain focus and concentration in the classroom. They also suggest that relatively brief, child-focused, training interventions can lead to significant improvements in attention and cognitive control. The contributions of the following studies are useful for the development of specific modules to be included within larger scope interventions.

• Working Memory Training Program. Klingberg et al., (2002) examined the efficacy of a programme designed to improve child attention skills by targeting working memory. The exercises in this programme are computer-based and involve training on visual-spatial, backward-digit, and letter span tasks. Over the course of 20 days participants showed improvement in attention in the form of improved reasoning ability and scores on the Stroop-tasks. Participants also showed improvement’s on Raven’s progressive matrices. One limit of this programme is that it was tested in a sample of five- to seven-year-olds diagnosed with ADHD. Nonetheless, in the same study, the findings were replicated with adults without ADHD. As such, given its effectiveness with a non-clinical adult sample, it is possible that this programme can be adapted to benefit non-ADHD pre-school aged children. Furthermore, the relative simplicity of implementation of the computer exercises and the positive results of the current trial suggest that the inclusion of these exercises can enrich larger scope classroom engagement intervention programmes.

• Attention Training Intervention. The objective of Rueda and colleagues (2005) original training programme was to help prepare monkeys for space flight. By adapting the content of this programme for children, the authors found positive effects of their specific training exercises on subsequent attention skills in four- to six-year-olds. Furthermore, these effects were observed above and beyond the influence of genetic factors, which are known to explain a lot of the variance in cognitive control (Barnes, Dean, Nandam, O’Connell & Bellgrove, 2011). Training sessions were held over nine days on three modules targeting attention: stimulus anticipation and discrimination, and conflict resolution. Participants performed tasks on a computer to fulfil their training on each module. For stimulus
anticipation, children learned to anticipate the movement of a duck on a computer screen. For stimulus discrimination, children selected a previously viewed portrait from a group of portraits. Finally, for conflict resolution, children performed a Stroop-like task where they were asked to identify which of two sets contained more elements. Conflict was introduced by presenting a smaller set made up of larger digits (a set of three number nine’s) versus a larger set of smaller digits (a set of nine number ones). Evaluations showed that children who underwent the training improved their conflict resolution skills and showed improvements in attention and intelligence relative to controls (Rueda et al., 2005). Research should evaluate the sustainability of the effects over time. Furthermore, it would be useful to determine whether the improvement in attention observed in this programme translate into better task-orientation and focus in the classroom.

Summary
In sum, specific cognitive control training programmes have been successful in targeting, inhibitory control, cognitive flexibility, planning, reasoning, working memory; and attention skills in pre-school aged children. These skills represent prerequisites for behavioural regulation, task-orientation, persistence, and focus in the classroom. Although no programme has comprehensively targeted classroom engagement as their primary focus, programmes that have addressed specific components of cognitive control in young children have generally led to improvements in children’s ability to remain on-task in the classroom.

The success of interventions, such as Tools of the Mind and Montessori, which are administered mainly by teachers, is promising. Many pre-school and elementary school teachers report facing challenges in the classroom due to child behaviour problems and poor self-regulatory skills. Indeed, poor self-regulation on the behalf of children is a factor that contributes to growing rates of teacher burnout (Hastings & Bham, 2003). Not surprisingly, when surveyed about the student characteristics they favour most, student compliance, attentiveness, sitting still, and listening are among the most common teacher responses (Rimm-Kaufman, Pianta & Cox, 2000). As such, programmes and curriculum that are easy to administer and which aim to improve engagement are likely to be met with enthusiasm by teachers.

One limitation of current interventions (with the exception of the REDI and Incredible Years) is the absence of parental components. A continued collaboration with parents may further improve the outcomes of promising interventions, especially in light of the findings that early family characteristics are likely to play an important role in the development of school readiness (Mendelsohn et al., 2011). Furthermore, as suggested by research findings, children may benefit from continued support in the home, and the added involvement of their parents in educational interventions. For most programmes one limitation was not following-up the long-term sustainability of their results. Better understanding the durability of these effects can help inform decisions over how and when to implement these programmes. It can also inform...
the introduction of possible booster components. Finally, a promising programme should offer the possibility of more individualised approaches based on specific child characteristics and need. For example, some children may need more training on attention control, while others might need help on working memory, or emotional regulation. In sum, pre-school intervention programmes, which include training exercises organised into modules that target self-regulation, appear promising for improving classroom engagement. It would be ideal for such programmes to include complementary and individualised mutually reinforcing child, parent, and teacher components.

Limitations and future research
Most of the studies reviewed were conducted with North American samples. Replication with international data and sub-populations presenting higher levels of risk factors are needed. The correlational methodology employed in most of the reviewed studies precludes the possibility of making causal inferences about the relationships between classroom engagement skills and later child outcomes. Nevertheless in most of the reviewed studies, known confounders were taken into account to reduce the possibility of third variable bias.

Finally, future research should examine, which factors can serve as moderators and mediators of the relationship between classroom engagement and later academic adjustment. For instance, teacher characteristics including teaching style would be of potential interest. It may also be informative to examine whether supportive parental practices and positive attitudes towards child education during the school years also play a role in modifying the relationship between engagement and achievement. In particular, poorly engaged children who also have unsupportive parents, may be especially at risk of experiencing negative academic outcomes (Bernier et al., 2010; Blair & Diamond, 2008; Ladd, Birch & Buhs, 1999). In addition, peer relations and children’s relationships with teachers may also serve as possible mediators of the relation between engagement and later academic adjustment. In particular, disengaged children who are more disruptive may be more likely to face peer rejection. This might, in turn, lead children to develop feelings of anxiety and frustration, which could undermine concentration and academic performance. Furthermore, in future studies it would be useful to apply a more transactional approach in which the bi-directional links between early childhood risk factors and family risk characteristics on subsequent child regulation and school readiness are taken into account. Finally, some research has examined population heterogeneity by looking at subgroups of children that followed distinct trajectories of engagement over time. However, it would also be informative to examine possible subgroup differences in risk factor profiles. As such, future research with similar data should examine whether subgroups of at-risk children can be identified and whether these subgroups follow different courses of academic adjustment over time.
Conclusion

The current crisis in education demands that we increase our ability to understand which skills, if targeted, are likely to bring about improvements in children’s academic performance, high school completion, and eventual productivity in the workplace. Taken together, several studies provide evidence that considering classroom engagement skills in terms of the ability to work autonomously and follow directions, can predict later academic performance and psychosocial adjustment, even while adjusting for kindergarten math and verbal skills, and family risk characteristics. This review also suggests a robust association between early cognitive control skills and the development of kindergarten classroom engagement skills. Finally, individual differences in engagement were observed over the course of elementary school suggesting that children presenting cognitive and familial risks in early childhood may be more likely to show low engagement across the grade school years. The present findings therefore suggest that assessing classroom engagement skills at school entry may represent as useful strategy for identifying children who face risks for both academic and psychosocial adjustment problems in later elementary school.

Upon merging scholarship in the fields of education and cognitive neuroscience, we propose that productive work habits in the classroom are likely to represent ecological manifestations of cognitive control skills. Such skills help individuals suppress automatic and less effortful responses in favour of more deliberate and thoughtful actions (Diamond, 2006). Furthermore, from an educational perspective, engagement represents an important mechanism of achievement because it is directly related to being on-task and following directions in the classroom (Fredricks et al., 2004).

An examination of the outcomes and antecedents of classroom engagement also support a conceptualisation of engagement as a contextual manifestation of self-regulation. For one, better classroom engagement was predictive of academic and psychosocial adjustment, both of which have also been shown to rely on child cognitive and emotional regulation. Second, measures of working memory and impulsivity were predictive of classroom engagement skills (Razza et al., 2010). This relationship was robust and revealed no mediation by intellectual skills and socioeconomic factors.

From a policy standpoint the present findings are promising. First, cognitive control appears to play a role in achievement beyond that of IQ and socioeconomic status. Second, research on cognitive control is generally conducted in a controlled laboratory setting. However, studying engagement in the classroom setting, as observed by teachers can help us understand how children’s actual contextual application of effortful control is related to later outcomes. Third, in addition to being related to academic outcomes, classroom engagement skills also contribute to better psychosocial and interpersonal adjustment. Finally, classroom engagement skills are malleable and amenable to interventions. How children begin their educational journey has important repercussions on their academic experience, and eventual quality of life. The current review provides evidence that assessing classroom engagement skills can help identify at-risk children. This represents an important step to ensure that all
children have the opportunity to start school on the right foot and experience success to their full potential.

References


Strengthening foundation phase teacher education through mentoring

Abstract
This paper explores a multidimensional mentorship model implemented between lecturers from the foundation phase at the Wits School of Education and four master’s students from the University of Limpopo, as part of the Departments of Education’s research initiative to strengthen foundation phase teacher education. Using three critical incidents, we interrogate mentors’ experiences of their mentoring practices. Two sets of literature, mentoring and social capital are used as a lens for analysing these incidents. Initial findings suggest the relationship has moved from the initiation to cultivation stage (Kram, 1985; Ragins & Kram, 2007). But, cultural preconceptions, implicit assumptions and institutional practices can impede or enhance information flows and trust. It is argued that weak ties characterised by mentors’ heterogeneity is a strength that has resulted in growing professional development. Through a process of reflection-on-practice, we have begun to think of ourselves as a fledging community of practice. This opens up possibilities for the larger research project.

Keywords: foundation phase (FP); mentoring; social capital; critical incidents.
Introduction

In South Africa primary education is in crisis (Fleisch, 2008). One of the crisis areas is teaching and learning in the foundation phase (FP) which, as the name implies, sets the foundations for learning. There is a critical shortage of FP teachers as well as suitable opportunities to appropriately train them (DBE & DHE, 2010). One of the current responses to this challenge is a government research initiative aimed at strengthening the capacity of the Higher Education System to provide more and better FP teachers. As a consequence, Higher Education Institutions (HEIs) were invited by the Department of Higher Education (DHE) to submit proposals for inclusion in the FP intervention, which is funded by the European Union (EU).

The Wits School of Education (WSoE), which has recognised expertise in the FP phase and a clearly defined approach to FP teacher education, put forward a research proposal focused on the establishment of a FP community of practice (CoP). The proposal acknowledged the wide range of processes, challenges and characteristics involved in the establishment of such a community. As Wenger (1998) asserts, practice that coheres with the notion CoP has three dimensions, namely mutual engagement, joint enterprise and a shared repertoire.

These three dimensions we posit, developed in a community of practice, could strengthen FP teacher education. In short, our overall aim is to establish and develop a FP CoP that will further teacher education in the FP and in so doing increase learning opportunities for all South Africa’s young learners.

A first step towards this aim was to set up a partnership with the University of Limpopo (UL) who do not have a FP teacher education programme. The partnership itself has two central foci. The first is to bring together expertise from both universities and collaboratively design a contextually appropriate FP teacher educator programme for the UL. The second, which is an integral part of the first, is a mentorship model whereby four teachers identified by UL come to the WSoE as postgraduate master’s students to gain expertise in the FP and subsequently lead the establishment of a FP teacher educator programme at the UL in 2014. It is expected that during their two years at Wits they will acquire the necessary social capital, for example disciplinary knowledge, to enable them to design and implement a contextually appropriate FP teacher educator curriculum.

This paper reflects on the first six months of the mentorship process from the perspective of the WSoE mentorship team. It asks what we as mentors are learning, and have learned from the mentorship process and it explores the relationship between mentoring and social capital in the context of this project. In this paper we are stepping into a dialogic space in which we hope others will join us. We must stress that we do not intend to exclude the voices of the four UL mentees but that this is the first part of the conversation.
A mentorship process unfolds

Mentorship, as Ragins & Kram (2007) note, is a multifaceted and highly complex process. It brings together disparate views and expectations and demands of all involved flexibility, commitment and a reciprocal willingness to learn. The WSoE mentoring team consists of five members, one man and four women with a range of expertise and experience. Various factors influenced the choice of mentors. Some of these related to expressed interest in the overall project, the specific process of mentoring, and expertise related to teacher knowledge of FP practice and curriculum. All team members have had some experience of the mentoring process and were motivated by a commitment to strengthening FP teacher education in South Africa.

The four mentees, two men and two women, arrived after the start of the Wits 2011 academic year. After initial discussions held in collaboration with the UL project members, it was decided that each mentee would focus on a particular FP specialisation, while acquiring a general FP knowledge base. Of the four mentees, only one had had some FP teaching experience. Two others had been high school teachers and the third mentee had some experience in adult education.

The mentees limited involvement in the FP presented a particular challenge. For while FP teaching shares some pedagogical principles with the other phases in the General Education and Training (GET) band, it also has a range of discrete practices. It is these discrete practices that the mentees needed to acquire. To assist them in this and a wealth of other teacher educator related practices, a mentorship plan was drawn up collaboratively between the mentoring team and the mentees.

This plan was informed by a needs analysis that considered all aspects of their life at Wits from office space, computer use, residence, library access, FP staff meetings, WSoE staff seminars, course choices and timely registration for these courses. The reciprocal nature of the mentor-mentee relationship was established from the outset. The mentees were encouraged to shadow the mentors in all aspects of their professional work with students, lecturers in other divisions and each other. They attended lectures and, as their knowledge base grew, did some lecturing to undergraduate BEd students. The mentees were given readings with specific foci relating to disciplinary and pedagogical content knowledge often addressed in the FP. They partnered members of the division on the two pre-service BEd students’ three week teaching experiences. Mentees also attended modules of the Grade R training that the WSoE was delivering for the Gauteng Department of Education.

In addition, they assessed BEd students’ work to familiarise themselves with quality issues and misconceptions that arise, for example, in the teaching of literacy. Assessments presented an opportunity for some undergraduate FP students whose mother tongue is not English to write their assignments in their first language, because of the mentees’ knowledge of the FP students’ mother tongue. An additional advantage was the insight mentors gained into student learning. Opportunities, such as this, where mentor and mentee knowledge was brought to bear on a learning issue
resonates with the kind of mentorship model we have adopted which emphasises the reciprocal nature of learning.

This reciprocity and shared learning emerged during the different variants of meetings that were held weekly between mentors and mentees. Some of these meetings were one-on-one (between individual mentors and their mentee), and others were group-based where mentees and mentors all came together. The mentors also met as a team to reflect on the processes underway.

Members of both teams kept reflective journals, the contents of which often informed the weekly mentoring meetings. Guided self-reflection is an ongoing feature of the mentees’ immersion in the FP CoP. At these meetings issues that arose were openly discussed and perspectives from members of both teams brought to bear on the discourse.

During mentor meetings a number of critical incidents were identified. Some of these incidents form the focus of this paper. These incidents often illustrated vastly different perceptions relating to gender, culture, pedagogical issues, for example, teaching techniques, as well as power relations. The data collected from this discourse forms the basis of our data collection and also informs the ongoing development of the mentorship.

**Data set and analysis**
From the outset, structures were put in place to gather detailed records of the mentorship process from all perspectives. The mentors developed a guided reflection tool that was used by both mentors and mentees to capture emerging thoughts, both positive and negative, on the evolving project. The reflections recorded provided a discussion base for the weekly mentorship meetings and prompted avid discussion. All discussions, both formal and informal, were recorded in writing. Data also came from lectures, staff meetings, minutes of mentorship sessions and spontaneous interactions. Our data collection, which is ongoing, includes summaries of meetings (both one-on-one and group-based mentor-mentees and mentoring team sessions).

It was during the mentors’ meetings, while reflecting on the mentor-mentee process, that a number of critical incidents were identified. These critical incidents tell a story and often highlight important pedagogical issues. Analysis of these incidents can identify the significance, especially the emotional significance, of actions and events on people as they carry out tasks. Critical incidents are useful to explain a particular phenomenon and can identify issues that might require further attention and possibly research. As Tripp (1993) notes, reflection on such incidents is an effective way of identifying the various experiences and to come to a better understanding of the events described by them.

Our analysis was guided by three questions, namely, what were the events or circumstances that led to the critical incident? What were the behaviours of the agent that made these events or circumstances a critical incident? What did we learn from the incident? We were also mindful that the interpretation of critical incidents requires empathy, as participants could reveal sensitive information.
In order to understand these critical incidents that allow us to go beyond a descriptive account, we draw on two sets of literature: research that comes from the field of mentoring and theory on social capital.

**Literature on mentoring**

Traditionally, mentoring has been defined as an intense, dyadic relationship in which a more senior, experienced person, called a mentor, provides support and assistance to a more junior, less experienced colleague, referred to as a protégé or mentee (Hezlett & Gibson, 2007). Although much of the literature uses the term ‘protégés’, we prefer to use mentees in the context of this project as our mentees are not protégés in the traditional sense. Our mentoring model is also not a dyadic relationship. Rather, the linearity of traditional models does not suit the context of this project. We have an alternative model of mentoring. This model is multidimensional. It is depicted diagrammatically in Figure 1 below. It represents shared thinking and feedback across three stakeholder groups: the universities, the mentors and the mentees. The model also works from the individual to the group and the group to the individual. There are two sets of mentors for mentees, one at Wits and one at UL. Mentees have their own Wits mentor, but also work with the other Wits mentors who have specialised expertise. Wits mentors collaborate with each other on the mentoring programme.

**Figure 1:** A multidimensional mentoring model.

A core feature of mentoring is that it is a developmental relationship embedded within the career context (Ragins & Kram, 2007). The primary focus is on career development and growth. Career functions involve coaching mentees, sponsoring their advancements, increasing their positive exposure and visibility, and offering protection and challenging assignments. In our case, mentoring involves the support of mentees in moving from one career to another where they will be required to take on new roles and responsibilities. This cannot be done without building relationships. Mentoring also involves psychosocial functions that build on trust, intimacy and interpersonal bonds. It includes behaviours that enhance and develop the mentees’ professional and personal growth, identity, self-worth and self-efficacy.

As a developmental relationship, Kram (1985) has identified four phases of mentoring: initiation, cultivation, separation and redefinition. The initiation phase
looks at career functions. Our initiation phase was characterised by mentoring sessions that focused on preparing mentees to access FP disciplinary knowledge and plot their trajectory as master’s students. The cultivation phase is marked by strong interpersonal bonds and a mutual exchange of ideas and information. This should include a sense of trust and information sharing between mentors and mentees. The separation phase involves a situation where one of the mentors or mentees leaves the organisation or psychologically outgrows the relationship. If the relationship does not disband at the separation phase, it moves into the redefinition phase, which is characterised by psychosocial functions.

There is little research on mentoring from the mentors’ perspective particularly in education. But, in dealing with education, Cochran-Smith & Paris (1995: 183) argue that a mentor’s role is defined by a list of activities including orienting the beginner to school and higher education policies, procedures and expectations and providing ‘feedback, coaching and support’ where interactions should be sensitive, non-judgmental and supportive. This is a useful starting point. Successful mentors display common attributes. They have an ability to listen, communicate and read people. They have patience and a knowledge of the organisation and industry (Allen & Poteet, 1999). Mentoring is most effective when it incorporates practical help, such as providing guidance or giving feedback. Good mentors provide regular times to meet, give immediate feedback and are available to mentees (Jones, Reid & Bevins, 1997). But, Holland (1995) does argue that there are complexities in mentor roles, which may be heightened in the mentor-mentee relationships in teacher education.

Research suggests that mentoring brings a sense of meaning and purpose to mentors, for example, the mentee can be a catalyst for the mentor’s professional development (Huling & Resta, 2001) and stimulate self-reflection (Peterson, 2006). While this may be so, Eby (2007) notes that little research exists on the actual and anticipated benefits of mentoring for mentors. Allen (2007) proposes that work needs to be done to chart the outcomes of high quality mentoring relationships, especially from the mentor’s perspective. This project aims to document just this.

**Social capital theory**

While there is a large body of work on mentoring, this project does not fit into a traditional model as outlined above. The complex nature of this project involves international, national, provincial and local stakeholders, and we have for this reason applied an alternative mentorship model. But, this model is still institutionally located and it was felt that a broader perspective that accounts for the current issues facing FP education in South Africa was needed. So we turned to the theory of social capital as a way of beginning to understand the processes we are experiencing as mentors.

Capital can be expressed in different ways; it can be financial, physical, human, natural or social (Mubangizi, 2003). Mubangizi (2003) argues that without social capital community goals could not be met even if other forms of capital are present. For the purposes of this paper, we draw attention to the word ‘capital’ in the concept
social capital. It implies the notion of possession of resources, but resources that can be circulated within a group. When resources circulate people benefit but not all may benefit equally or at the same time. A good capital investment implies a growth of resources and collective benefits for a group.

Social capital has been defined in various ways and its definitions are not consistent (Storberg, 2002). We work with Coleman's (1988) approach in this paper. Coleman (1988) defines social capital by its function, which comprises aspects of social structures and the actions of actors in the structure. In our case social ties (see below for an explanation) are formed through the mentoring programme, a social structure, and mentors and mentees are the actors within it. For Coleman (1988) social capital is productive and linked to human capital. Human capital brings changes to people by imbuing them with skills and capabilities that make them act in a particular way (Coleman, 1988). This explanation resonates with our project, the aim of which is to develop these skills and capabilities within each other.

In tertiary institutions knowledge production is fundamental. But, early childhood education is under-researched in South Africa, thus building a knowledge base is critical. Kessels and Poell (2004) contend that social capital assists knowledge creation and sharing. These are essential contributors to developing networks and collaboration. In line with Lin (2001), we argue that social capital is an investment in social ties in order to access resources of those in a group is a way of developing knowledge in our field.

Coleman (1988) discusses three features of social capital in the creation of human capital: obligations; expectations and trustworthiness of structures; information channels, norms, and effective sanctions. In the mentoring process we have a set of expectations and obligations to each other. For example, the expectation on the part of the whole group is that a mentoring session will take place. Mentors are obliged to run mentoring sessions. At times, when needed, a mentor with a special area of expertise will run a mentoring session. Another mentor with different expertise will be obliged to repay this ‘favour’ at another time. In doing things for each other, and in collaboration with each other, a trustworthiness in the social environment begins to grow and an unsaid commitment to repaying the obligation is practised.

The concept of trust is core to literature on social capital. Hezlett and Gibson (2007) discuss five aspects of trust. The first is that cooperative behaviour is related to levels of trust. Secondly, cooperation and trust are reciprocal. Thirdly, trust can be multidimensional, in other words it can be fragile, resilient, or generalised. Fragile trust refers to actors who expose their vulnerability in daily interactions. For example, in a mentor-mentee meeting a mentor admitted to sometimes feeling overwhelmed by research deadlines. In contrast, resilient trust is underpinned by the fact that both parties will not always benefit from the relationship, or benefit equally, but there is an acknowledgement that there will be some benefit. Mentees receive the benefit of knowledge and experience from experts in the field. This benefit, as the mentees noted, has shifted as our relationship with each other has grown and changed over
time. As mentors, it could be argued that in publishing this paper a different kind of benefit accrues to us. Generalised trust can occur when individuals adhere to norms and behaviours of a larger group although they may not have much direct contact with each other. The three individuals involved in the mentoring process knew each other, but had not worked together collaboratively until this project. There was a generalised trust from their knowledge of each other at the university that working together would be possible.

Social capital is characterised by social ties. These have been described as strong ties, like the ties friends have with each other, or homogenous groups. They are also known as bonding social capital (Helliwell & Putnam, 2004). Social ties can also be weak, or in the words of Helliwell and Putnam (2004), bridging social capital where groups with little in common work together. These are characterised by heterogeneity. Strong ties appear to build trust whereas weak ties can be fragile. But weak ties extend networks, and use diversity as a resource. Finally, strong ties are not a prerequisite to developing trust. This project is characterised by weak ties. Distance and history mean that the two universities have traditionally had weak ties. In now working together networks are being extended to the mutual benefit of both universities.

The exchange of information is fundamental to social capital and is a means through which action can be taken (Coleman, 1988). One of the ways in which people acquire information is through social interactions. In relationships where there are weak ties, information can be provided from a variety of perspectives. When FP practitioners at all levels are expected to be generalists this is beneficial. The level of institutional, academic, disciplinary and professional knowledge that the mentees require cannot be supported by one mentor. In order to address this, the model provides mentees access to many mentors to deepen their knowledge.

Norms are forms of social capital and can facilitate action or constrain it. Coleman (1988: 104) adds a nuance by stating,

A prescriptive norm within a collectivity that constitutes an especially important form of social capital is the norm that one should forgo self-interest and act in the interest of the collectivity.

Thus an individual may not benefit directly when they adhere to a set of norms, but the collective benefits. But norms and sanctions are often implicit, invisible and entrenched in institutional practices. Newcomers, as is the case of our mentees, enter a space in which the rules and expectations of a university are both different and similar to their schools as workplaces.

Much of the work on social capital and mentoring align with each other and it is to this point that we now turn.

Social capital and mentoring research

Hezlett and Gibson (2007) argue that most of the work in social capital and mentoring has developed in parallel. Only recently has there been a move to bring the two traditions together. In their review of the research they posit that there is a reciprocal
relationship between social capital and mentoring where concepts of social capital enrich mentoring and vice versa. Thus, in the next part of the paper we draw together the stages of mentoring, roles of the mentor and Coleman’s (1988) theory of social capital as a way of analysing the dynamic relationship between this group of mentors and mentees. We argue that bringing social capital together with mentorship is also the start of understanding larger social networks of which we are a part, and an initial step in considering the ways in which a community of practice may evolve.

The issue of trust emerges in both bodies of literature. But, social capital sees trust from a structural perspective rather than being located in a psychosocial relationship. This broader and slightly more nuanced understanding of trust provides us with a more complex analytic tool with which to assess issues of trust, collaboration and knowledge-sharing as mentors. Since there is little literature on multiple mentors (Hezlett & Gibson, 2007), the concept of weak and strong social ties from social capital, provides a means of exploring this more complex mentoring model.

Good communication and feedback characterise a successful mentoring relationship. But what is largely absent in the literature, is the content of this information and the information flows. This is unsurprising when mentoring relationships in corporations are often between individuals who already have knowledge of the field. But, what characterises this mentoring relationship is the dissemination of disciplinary knowledge, practical knowledge, pedagogical content knowledge and institutional knowledge of tertiary teacher education. Social capital’s framing of information exchange illuminates this fundamental part of the mentoring relationship.

Initial findings from a mentor perspective: three critical incidents

We now present three critical incidents that we hope provide insight into the role and lessons gained from the perspective of the mentors. These are presented as reflective narratives.

Critical incident one: Asked to leave

It was Thursday morning, my mentee and I had planned a numeracy lecture together which he was now going to present. I went with him to the lecture room and explained the plan for the day to the students. Immediately thereafter, my mentee asked me to leave the lecture room. This sudden request for me to leave left me wondering why, more so because the request was verbalised in Sepedi. (Sepela, o ye offising ya gago. Nna ke lokile. Rona re lokile. Loosely translated, he said, “Go to your office. I am fine. The students and I are fine.”) I did not know how to respond in front of everybody, because I did not want to appear disrespectful to my mentee so I left.

As I left the lecture room – and subsequently – reflected on what happened I realised how uncomfortable this incident made me. I was left with many unanswered questions and still seek answers to the following: Did he ask me to leave because he did not understand my reasons for asking him to do this lecture? Was he perhaps suspicious of my intent? Was this fuelled by a lack of explicit communication on my part? Is everything as clear to him as it is to me.
or is my understanding of the role of the mentor, my perspective on what he should assume, in fact ‘clouding’, unintentionally, understanding?

Was there a culturally-based element impacting our relationship, I also asked myself. I am a middle-aged African woman mentoring a young African man. I am also a woman from a different province with different cultural belief systems and expectations. These different cultural and belief systems could, I concluded, generate previously unarticulated complexities in the mentoring process. For instance, in some African communities, mostly in deep rural areas, men are viewed as superior to women. As a woman from the city, mentoring a ‘rural’ man I have often had to think carefully about what I do or say to my male mentee. This male mentee may also expect me to behave in a particular manner as an African woman.

Had I failed, I asked myself, to make the implicit explicit? Should I, from the outset, deliberately have delved, and negotiated, a way through this complex, highly sensitive, culturally-based feature of our relationship? Or had I been assuming that professionalism would, in both our minds, place cultural issues on a different trajectory? Was this naïve? What is the relationship between culture and professionalism? Reflection brought all these issues to the fore.

My aim in asking my mentee to present the numeracy lecture was for him to get an opportunity to present a lecture and interact with students in order to sharpen his FP numeracy content knowledge and presentation skills. I had spent some time with him beforehand where we had discussed the lecture and I had given him the lecture notes and handouts. We had agreed on the time and date for the lecture.

Furthermore, the lecturing approach I had modelled was cooperative, collaborative and highly inclusive. Yet, it had spawned exclusion. Why? My expectation was that the mentee would follow the lecture/review approach that I had been modelling for a number of weeks. In this approach I would lecture while he observed and then, after the lecture, we would review collaboratively what had taken place and how the pedagogical content knowledge had been mediated. I therefore expected that when my mentee presented a lecture it would follow a similar approach. But I didn’t make my expectation explicit and that, on reflection, may have been a mistake. Perhaps it led to the mentee’s unexpected request for me to leave.

In short, my expectation, as a mentor, was that the model of shared review that I had followed would be equally applicable when we switched roles and he was the lecturer and I the observer. Furthermore, what role, if any, had trust, or lack thereof, played in the creation of this critical incident? Had the level of trust in our mentoring relationship not developed to the level where the mentee could open himself up to possible critique? Would my presence and our joint review expose an area of vulnerability that he was not yet ready to reveal?

In short, I had obeyed his command. As mentor, I had not wanted to cause a scene and challenge the mentee in a public space as there are institutional norms that govern behaviour in the classroom and relationships in the project. And these norms present boundaries within which I operate. But was there also another factor, I pondered. Was culture and my embedded knowledge of its power a central factor in my departure? Which norms take precedence? Institutional? Cultural? And is one always aware of the unspoken power of norms that may at one stage have been woven into your identity?

As a team, we turned to social capital theory as a way of trying to understand the processes we are undergoing as mentors and, in relation to this critical incident, why M had been asked to leave.

Norms are forms of social capital and can facilitate action or constrain it (Coleman, 1988). In the case of M’s critical incident, institutional norms and expectations
appeared to be diametrically opposed to those held by the mentee. But, as we noted earlier, norms and sanctions are often implicit, invisible and entrenched in institutional practices. Newcomers, as is the case of our mentees, enter Wits which has its own rules and expectations. The necessity of negotiation and explicit articulation of the embedded norms of the mentoring programme which are shaped by invisible institutional norms is obviously key.

M’s deference to her mentee’s request to ‘leave’ raised issues in her mind about culturally-based power relations. Her reflection on this illustrates the tension that can arise as institutional and cultural norms jostle for precedence. They also potentially open a space for negotiation that in itself can further understanding of the multifaceted and complex nature of the mentor-mentee relationship.

As the mentoring process continues, the weak ties to which we have referred will, we anticipate, provide rich learning opportunities for all parties. Weak ties are often related to heterogeneity, and the heterogeneity of the mentor team is an undoubted strength that is able to deepen insight and broaden understanding. As the mentor team collaboratively reflected on M’s being ‘asked to leave’, differing interpretations arose that stimulated discussion and debate. A number of members of the team realised that their cultural frames were not only shaping their interpretation, but impacting on their immediate ability to ‘read’ the incident through the eyes of M.

As a mentor team we are trying to construct mentoring as collaboration. The collaborative, reflective relationship M has established with her mentee was jolted as it became apparent that her expectations and his were mismatched. M acknowledges in her reflection that she had not anticipated this mismatch and that if she had made her expectations explicit at the outset the critical incident may not have occurred.

As Coleman (1988) asserts, social capital is linked to human capital, which brings changes to people by imbuing them with skills and capabilities that make them act in a particular way. In the ‘asked to leave’ critical incident, the aim of the mentor was to enhance human capital. The emotions and confusion she encountered through the action taken by the mentee made her question her ability to generate human and social capital in others. And her ability in this regard, and confidence in this ability is, we argue, a process of growth.

Another aspect of social capital is trust (Coleman, 1988) and M’s reflection clearly identifies issues relating to this theoretical construct. This incident reveals the operation of fragile trust (Hezlett & Gibson, 2007). In M’s critical incident, she had made an assumption that there was an element of trust between her and her mentee, because they had been in the mentoring relationship for almost three months. She assumed that the mentee would trust her enough to be able to present a lecture in her presence, and that the fragile trust that existed between them would permit him to expose himself to situations that might unsettle him and make him appear vulnerable, e.g. a student asking a question for which he did not currently have the knowledge base. This ‘risk taking’, she assumed, would not be difficult for him because of the fragile trust that existed between them. But was that fragile trust, in fact, in place?
Cooperative behaviour is related to levels of trust. In this critical incident, M’s shock and confusion on being asked to leave could be linked to the expectations she had, and assumptions she had made that her mentee would be sufficiently cooperative and possess enough trust to follow the lecture/review model she had presented to him as the norm.

Finally, the critical incident raised questions around the establishment of trust and that it cannot be assumed to be in place or developed within a short space of time. It also raises questions about the cultural frames we operate in and that institutional and cultural norms may often be in tension with each other, which can lead to misunderstandings and misinterpretations of events that impact on developing collaborative relationships. It also points to broader relationships between schools and universities about what it means to teach FP.

Critical incident two: Dare to ask

A discussion between two mentors and two mentees at a weekly mentorship meeting was the context for this incident. Prior to this discussion during a master’s session, one of the mentors had presented a conceptual paper that she had co-authored, and which looked among other things at the link between play and emergent literacy. During the mentorship discussion, one mentee queried why no concrete examples of play had been given in the paper. This opened a space to explore the notion of play from a cultural perspective. The mentees pointed out that in rural Limpopo girls had few opportunities to develop gross motor skills in the context of outdoor play, as they were not expected to climb on jungle gyms and other large outdoor equipment. Rather, they would be inside engaging in more sedate activities where the emphasis is on fine motor skill development, activities such as ‘diketo’ (a numeracy game which involves addition and subtraction), weaving mats and threading beads. The boys, however, were expected to partake in active outdoor play and not focus on the more sedate indoor activities. Suitable activities for boys include playing with wire cars, climbing trees and soccer. It is considered demeaning for boys to participate in girl’s activities, and if girls play boys’ games it is viewed with disdain. These observations offered by the mentees led to a rich discussion about cultural norms in the relation to play and the role of play in early learning.

This incident, we argue, resonates with many of the constructs depicted in social capital and mentoring literature. The mentorship relationship follows distinct phases (Ragins & Kram, 2007). We would argue that this critical incident suggests a shift in the relationship from initiation to cultivation, whereas the first incident is located in the initiation phase. The discussion that emanated from this initial question led to a mutual exchange of ideas and information. The evidence of mutual exchange and reciprocity in mentoring sessions is accentuated when both mentors and mentees together identify, read and critically discuss articles relating to disciplinary knowledge. By ‘daring to ask’, mentees demonstrated that a strong interpersonal bond was beginning to develop, which was based on a sense of trust.

As Ragins & Kram (2007) note, trust is an important psychosocial component that frames the mentoring process. Trust is characterised by increasingly positive interpersonal relationships between mentor and mentee. And this indeed proved

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to be the case. Over time a congenial atmosphere has developed between the two mentees and mentors. This has deepened into what Hezlett and Gibson (2007) identify as a reciprocal relationship of cooperation and trust. It was, in part, this growing relationship, we suggest, that allowed the mentee to critique the paper and the mentor to open a dialogical space for further debate. Is this evidence of the mentees’ increasing professional and personal growth? And has this growth been aided by the mentors whose role is to provide support in a sensitive, non-judgmental environment?

This emotionally safe space facilitated the sharing and exchange of information relating to different culturally contextual practices: in this case how children play and different cultural expectations of their play. The mentees felt confident enough to share disparate understandings of play informed by their cultural contexts. As the team began to explore differences we also began to tease out similarities. This exchange of information by both mentors and mentees enabled the mentors to re-examine their understandings of play from culturally diverse contexts. The mentors come from a context that views children as being embedded in a dominant western European culture. For the mentors this exchange of information was an illuminatory insight. And for the mentees, we suggest, this empowered them to draw from their rich knowledge base and the power relations were reversed as they were placed in a position of strength. They were also ‘the experts’.

Social interactions of this nature provide a platform for deepening information exchange, which is a fundamental tenant of social capital (Coleman 1988). The weak ties that characterise this project further enabled a two-way flow of information. The two mentors bring disciplinary and professional knowledge to the relationship and the mentees a knowledge of culture and context that opened space for critique and exploration.

In short, this critical incident shows how specific social interactions enable disparate groups of people to share differing information, which often draws on specific cultural understandings. The ongoing development of trust, which is characterised by weak ties, has enabled the mentees to shift their positions from one of initiation to cultivation.

Critical incident 3: What did you expect?

All the mentors came together at the beginning of the second semester to ‘touch base’ and think about the format mentoring sessions might take as the mentees began their academic course work. This would bring about another dimension to the mentoring relationship. The academic demands of course work would require a different approach to how we mentored. In the process we began to talk about our expectations of the mentees in other aspects of our work with them. At this time of the year we are under pressure to have all mid-year marks posted. It emerged that some marking had been given to mentees and not all of it had been returned. Questions were then raised about the mentees’ role and function in the division: they are colleagues and at the same time not, they are postgraduate students but not bursars paid to work within the division, marking or teaching are valuable learning experiences to begin to
lecture and assess, but this is not a formal part of ‘training’. This discussion came to define the rules of engagement.

We realised that we had never set out what our explicit expectations were at the beginning of the mentoring process. It was such an obvious oversight. If students did not know the institutional practices, in this case around marking, because we had never told them they could not be expected to know how this put us under pressure. Rather than leave this unsaid, we decided that talking about expectations needed to be done. It was decided the mentor who is the Division Head would meet with the mentees. In this meeting the past six months could be reflected on, and goals set for the coming months, as well as a discussion about both groups’ sets of expectations that had or had not been met, and what the expectations would be going forward.

In analysing the ‘what did you expect?’ critical incident, Coleman’s (1988) three concepts of social capital emerge as interconnected. Expectations and trust are built on norms for a group to function. When a group has weak ties and is not part of the same institutional culture, there needs to be an information exchange for these norms to be made explicit. In retrospect, setting out expectations seems an obvious starting point when beginning a new relationship. The question then is why this did not happen. We believe that some of the answer lies in the way in which we thought about the initiation phase of mentorship. Because we had not been involved in a mentorship process like this before, we drew on our institutional social capital around registering students and settling them into accommodation, and their new role. We worked from a ‘student orientation’ perspective which emphasises logistical aspects. The focus is on students feeling secure in a new environment. But these were not ‘normal’ students; they are individuals who have a more complex identity. In foregrounding mentee needs, what was backgrounded was the role of mentors in setting up a collaborative relationship. When the focus is on logistics, and not on the nature of human interactions on both sides, we run the risk of not being able to fully develop relationships of trust.

This is where the exchange of information is crucial. In this case the exchange of information is about the joint set of expectations around the work ethic at Wits, what constitutes collegial behaviour, the ways in which the mentoring process takes place and preparation for meetings, time management, self-motivation and accountability. The exchange of information in the mentoring sessions is narrower and focuses on disciplinary and pedagogical knowledge as well as the impact of the psychosocial in the new academic endeavour. Information exchange is the means through which action can be taken. If the exchange of information is faulty then the actions that can be taken are compromised and the efficacy of the mentoring process is undermined.

In building trust, communication has to be explicit. In the absence of setting out explicit expectations, it is not clear what the general and specific obligations are for the group and can lead to misunderstandings. In the same way as we may misread a response because we may not have the appropriate cultural frame, mentoring is also about developing a frame for the group’s ways of being and working together collectively. The challenge is to continuously develop a relationship of trust with
strangers who are new to our environment and set clear boundaries that enhance collaboration rather than inhibit participation.

Thus in the exchange of information, norms are implicit and explicit. In this project we did not make the norms explicit. In revisiting these implicit expectations and making them explicit in the meeting with the mentees, we were lucky that on the whole there was agreement. But, we would argue that norms are not static and can be renegotiated as needs change. For example, the ways in which mentoring will take place in the second half of the year will be slightly different, where it was mutually agreed that there be more focus and support on the academic endeavour.

What this critical incident highlights for us is the value of reflection in unpacking incidents that force us to interrogate our own assumptions, beliefs and practices. This ‘obvious’ oversight has enabled us to plot the way forward with greater clarity and further define what our roles as mentors are. It is also a reminder of the dynamic relationship between human beings which allows for the development of human resources.

**Conclusion**

This paper reflects on the first six months of the mentorship process from the perspective of the WSoE mentorship team. It asks what we as mentors are learning and have learned from the mentorship process and it explores the relationship between mentoring and social capital in the context of this project. As noted in the outset of this paper, we did not follow a traditional mentorship model. Consequently, the mentoring process though disparate, and at times convoluted, brought together a range of views and expectations. This, we argue, became the strength of the mentoring process. It is clearly indicated in critical incident two when a mentee challenged a mentor and opened a pathway for dialogue and debate. It also signals a shift from the initiation phase to the beginning of a cultivation stage of mentoring. As mentors we are eager to see how this shift of position plays out with all the mentors. Mentoring has also brought other learning experiences to bear. Our experiences indicate the emergence of two distinct faces of culture. We have been forced to recognise that when one’s own cultural practices and beliefs are deeply embedded one is less aware of how they influence the interpretations of events. This, we argue, could be seen as the weak face of culture. The strong face of culture was clearly illustrated through critical incident two where differing culturally based perceptions of play led to rich reciprocal learning. We surmise that the weak ties between the mentor-mentee team allowed the mentee to speak out. Critical incident one aptly shows what happens when these ties are fragile. The mentor-mentee relationship becomes strained and it requires a sensitive, compassionate and reflective response from the mentor to ensure appropriate ties are established that will encourage risk taking and the appropriate exchange of information. This dichotomy between strength and weakness is also relevant to our own mentor team. The weak ties emanating from the racial, gender and cultural
diversity in the mentor team added strength to the range of interpretations brought to bear on all three critical incidents which, we argue, was generative.

The challenge for the mentors will be how these weak ties develop in the face of growing collegiality and, which the literature reveals, often leads to the strengthening of ties that could change the group dynamic. Furthermore, we suggest that the nature of the mentorship model we adopted has been a strength that opens space for a collective reflection on our practices. This has enabled us to interrogate some of our own practices which, as critical incident three reveals were found wanting, but also enabled us to make changes to the mentorship process.

Lastly, through this process of reflection-on-practice by the mentorship team we have begun to think of ourselves as a fledging community of practice. This has opened multiple possibilities for taking the larger research project forward.

References


Accessing and assessing young learner’s mathematical dispositions

Abstract

It is argued in this paper that there is an absence of literature relating to research on learner mathematical dispositions, particularly with young learners. Drawing on Kilpatrick, Swafford and Findell’s (2001) five interrelated strands of mathematical proficiency, which include: conceptual understanding, procedural fluency, strategic competence, adaptive reasoning and productive disposition, it is argued that there has been little engagement with productive disposition in the field of mathematics education and how we might access and assess this strand. Despite competence in all strands being essential for mathematical proficiency, literature and assessments that seek to establish learner levels of mathematical proficiency have tended to focus on the first four and have neglected the last; productive disposition. Finding ways in which to access student mathematical learning dispositions can be challenging, especially with young learners who struggle to articulate their views. An instrument is shared that the author has designed with doctoral fellow, Debbie Stott, in order to access and assess the productive disposition of learners participating in maths clubs run within the South African Numeracy Chair. The findings that emerge in one Grade 3 club with six learners is shared. These findings are related to the data collected through instruments that assess the other four strands of mathematical proficiency. This enables a holistic picture of learner’s mathematical proficiency as intended in the conceptualisation of the interrelated five strands of proficiency.

Keywords: productive disposition; five strands of mathematical proficiency, young learners.

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Contextual background and empirical field for the study

South Africa is facing a crisis in numeracy education as evidenced by sustained poor performance across international, regional and national assessments (cf. Fleisch, 2008; SACMEQ, 2010; Carnoy, Chisholm, Addy, Arends, Baloyi, Irving & Raab, 2011; DoE, 2008). For many years interventions have focused on improving performance of Further Education and Training (FET), and in particular, improving matric results. However, more recently, there has been increasing acknowledgement that interventions need to begin much earlier in schooling. In this respect the mathematics Education Chairs Initiative appointed two Chairs focused on numeracy education in the early years of schooling. Professor Hamsa Venkatakrishnan holds one such Chair at Wits University and Professor Mellony Graven holds the South African Numeracy Chair at Rhodes University. The focus of these Chairs is twofold: To nurture research in the field of numeracy education that is focused on searching for sustainable ways forward to address the ‘crisis’ and to improve learner numeracy performance in the schools where we do this work. Our Chair has partnered with numeracy teachers (ranging from Grade 0 to Grade 6) in 15 schools in the broader Grahamstown area to work towards the improvement of numeracy teaching and learning in these schools. This partnership enables access to numeracy classrooms as the empirical field for research. The teacher development programme of our South African Numeracy Chair at Rhodes University is the Numeracy Inquiry Community of Leader Educators (NICLE). This programme involves the establishment of a supportive community where teachers engage with numeracy concepts and the teaching of numeracy in fortnightly seminars and workshops. Additionally our Chair includes direct learner focused interventions in the form of mathematics clubs as an intervention strategy aimed at improving numeracy learning.

The first pilot club began in August 2011. In 2012 we have established one Grade 2 club, one Grade 4 club and three Grade 3 clubs, one of which is the focus of this paper. The clubs take place in varied contexts, including, an ex-model C school, an afternoon development centre that cares for learners from three of our participating schools, and a township school. The clubs have between six and 12 participating learners. In this paper, I report on the data in the smallest and first club established in 2012. The club is run from an afternoon development centre that caters for learners who require afternoon care, as their home situations do not enable this.

The clubs provide an after school informal learning space where we can engage directly with learners and research in more depth the nature of student numeracy learning and evolving proficiency. A focus of the clubs is on developing learner sense-making and shifting learner dispositions from being passive learners to more engaging, confident and actively participating learners (cf. Graven, 2011). A deliberate aim of the club is to create strong productive learning dispositions (defined below) within our clubs. The following table summarises some of the distinguishing features of the clubs, which is contrasted to the classroom environment.
Table 1: Formal vs. informal learning environments (cf. Graven & Stott, 2011: 95-96).

<table>
<thead>
<tr>
<th>Formal mathematics classroom/ environment</th>
<th>Informal club/mathematics environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compulsory attendance is expected as part of formal schooling (in-school-time).</td>
<td>Voluntary membership during out-of-school time.</td>
</tr>
<tr>
<td>Less learner choice over the activities that they work on and engage with.</td>
<td>More learner choice over the activities that they work on and engage with.</td>
</tr>
<tr>
<td>Curriculum and assessment standards as a prescriptive framework strongly influencing choice of content and activities.</td>
<td>Curriculum as contextual guide for what is nationally expected of learners, but individual learner numeracy levels guide content and activities.</td>
</tr>
<tr>
<td>Largely acquisition based and often driven by teaching for/to assessments.</td>
<td>Participation based. Participants are active and engaged.</td>
</tr>
<tr>
<td>Teacher led and much whole class teacher learner interaction.</td>
<td>Many interactions are learner led with few whole class-mentor interactions and many one-to-one interactions between mentors and learners.</td>
</tr>
<tr>
<td>Assessment tends to be summative and results in ranked performance.</td>
<td>Assessment is formative and integrated and used to guide individual learning experiences for participants.</td>
</tr>
<tr>
<td>Prescriptive, teacher controlled classroom rules within general school rules.</td>
<td>Negotiated sociomathematical norms (Yackel &amp; Cobb, 1996) which may differ from in-school time rules.</td>
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**Reviewing the literature**

A key aspect of teacher pedagogical content knowledge (PCK) is knowledge of students (Shulman, 1986). Ball, Thames and Phelps (2008) distinguishes between two subdomains of PCK, namely knowledge of content and students, and knowledge of content and teaching. However, literature tends to focus on teachers’ knowledge of learner’s mathematical competence and less on what teachers know of learner mathematical confidence, forms of participation, or mathematical dispositions and identities.

Kilpatrick, Swafford and Findell (2001) highlight the importance of a productive disposition as one of the five interrelated strands of mathematical proficiency. The strands include: procedural fluency, conceptual understanding, adaptive reasoning, strategic competence and productive disposition. Productive disposition, as they define it:

... refers to the tendency to see sense in mathematics, to perceive it as both useful and worthwhile, to believe that steady effort in learning mathematics pays off, and to see oneself as an effective learner and doer of mathematics (Kilpatrick, Swafford & Findell, 2001: 131).
In the sense that productive disposition involves ‘seeing oneself’ as an effective learner and doer of mathematics, and that dispositions commonly refer to a habitual tendency to act in a certain way, they relate to learner forms of participation and ways of being in mathematics classes and to learner identities.

Kilpatrick, Swafford and Findell (2001) similarly define teaching proficiency in relation to the five interrelated strands that correspond to the five strands of mathematical proficiency. While they explain a productive mathematics teaching disposition in relation to teacher knowledge, practice and learning, they do not elaborate on this, and no link is made to knowledge of learner dispositions, or to how teachers might access learner dispositions or draw on them in their practice and learning. While it is acknowledged that knowledge of students involves knowing learners’ levels of mathematical competence, and what they are able to do and not do, knowledge of student mathematical learning dispositions is generally ignored.

Similarly, mathematics assessments tend to ignore this aspect. Nationally administered numeracy assessments for young learners generally provide teachers with indicators of where learners are at in relation to the first two strands (cf. for example the Annual National Assessments (ANA’s) (DoE, 2008)). On the other hand, some internationally designed orally administered assessments are more comprehensive and gather data that can be related to the first four strands (cf. Wright, Martland & Stafford, 2006; and Askew, Rhodes, Brown, William & Johnson, 1997). However, I have not as yet found assessments that incorporate the gathering of information about the nature of learner’s mathematical learning dispositions. If this strand is, as Kilpatrick, Swafford and Findell (2001) suggest, one of five equally important interrelated strands of proficiency, then surely we need to find ways to support teachers to access and assess learner dispositions, in order to remediate and reinforce as needed. Assessing competence in the other strands may of course point towards a productive (or the absence of a productive) disposition, but the way in which dispositions relate to the other strands requires further investigation.

**Designing and piloting an instrument for accessing mathematical learning dispositions**

Since within our Chair we specifically aim to support learners to become mathematical sense-makers, mathematical negotiators and creative problem solvers, we aim to influence their way of being and their mathematical identities. Additionally we aim to improve learners’ mathematical competence in terms of various assessable criteria that we have adapted and adopted from the Askew et al. (1997) and the Wright et al. (2006) interview-based numeracy instruments. These provide us with clear data that allows us to track learner progress (or regression) on various key numeracy competences. We have thus far been able to, although with much work and some
difficulty; relate learner competences on these instruments to progression along a spectrum of proficiency for each of the first four strands (cf. Graven & Stott, 2012).

In 2011 we piloted an instrument with our first pilot club. The instrument included a row of learners, which showed Mpho and Sam as the weakest and strongest learners, at either end of a spectrum, respectively. Learners were asked to point to where they were in the indicated spectrum of learners and to describe Mpho and Sam (cf. the start of the revised instrument in Figure 1 below). The instrument deliberately refers to providing a description of others (even while learners often followed descriptions of Sam or Mpho with “I am …”) as this enabled a ‘safe’ and less personal space where learners could articulate their views. The names Mpho and Sam were chosen to enable the interpretation of both male and female genders. Reference to Mpho and Sam was also intended to reduce the sense that we were assessing learners in the interview. For the evolution of the instrument see Graven (submitted).

The findings of the pilot in our Grade 3 club in 2011 with 10 learners enabled us to see how learners positioned themselves within the class in terms of their perceived mathematical strength or weakness. Several learners responded by saying, “I am Mpho” or “I am Sam”, and when they described Sam and Mpho we were provided with inclinations of their stories about themselves. The data provided rich textured utterances on how learners perceived productive (and unproductive) learning dispositions. In this pilot club the dominant descriptor by learners for Sam was that s/he was someone who: listens to the teacher (6/10 learners), whereas working hard only received one reference across the responses. While not all learners provided responses for Mpho those who did described him/her in opposite terms to Sam, i.e. as not listening (4/10) (cf. Graven, subm.).

This enabled us to see the extent to which learner notions of an effective learning disposition were similar and/or different to the notion of a productive disposition. As a result, we were able to search utterances for indicators of criteria included in Kilpatrick, Swafford and Findell’s (2001) definition of productive disposition, that is, we were able to determine whether learners “see sense in mathematics”, “perceive it as useful and worthwhile”, “believe that steady effort in learning mathematics pays off”, and “see [themselves] as an effective learner and doer of mathematics”. Aside from those learners who identified with Sam (and thus by implication identified themselves as being an effective learner) there was little to point towards productive dispositions, and thus we were able to say that at the start of the club learners’ mathematical proficiency in relation to this strand was mostly absent or at best rudimentary. This influenced the design of our club activities.

Subsequent to the piloting we extended this instrument to include a few additional items as shown in our revised instrument:
Figure 1: Revised mathematics learning disposition instrument.

While this instrument is generating rich data, and will hopefully enable us to see whether participation in mathematics clubs supports evolving productive learning dispositions, we supplement this data collection with recording of ongoing observational data. Reflective journal writing follows each club session, which includes notes of each learner’s participation and proficiency as was observable in the club. These are later transferred to what we are calling ‘individual learner story cards’.

The findings from our first 2012 club

Our first 2012 mathematics club began with only six learners. The instrument was used as a baseline interview and, where necessary, was translated into learners’ home language. The small number of learners in this club allows me to report, with examples, on the findings across all six learners, so as to illuminate how the instrument enables us to access the mathematical learning dispositions of club members at the start of their participation in the clubs. This provides useful data in terms of planning activities so as to support establishing the club environment in order to meet the aims of maximising learner active participation, engagement, creative thinking and sense making.
The instrument begins with a ‘complete the sentence’ item: “Mathematics is ...” This item aims to elicit responses that enable us to see how learners perceive mathematics and whether they perceive it as something ‘useful’ and ‘worthwhile’. The six learner responses to this question indicated a perception of mathematics as the work/topic one does in the mathematics class. Two learners responded with simply “sums”, while another three responded with: “two times table; work with numbers”; “words and numbers”; “work, tests and sums”. One learner responded by explaining how the lesson unfolds by saying, “The teacher says it’s time for mathematics, gives us books, then she writes on the board, then we must write the answer.” The briefness of the responses provided limited insight into learners’ perceptions. On the other hand, when compared to a much wider range of responses across other clubs, which included descriptors of learner experiences of mathematics with responses such as: “fun”, “awesome”, “nice”, “good”, “important” and descriptors of “all about thinking” or explanations of how it relates to everyday problems to be solved, one becomes aware that the limited range of responses might indicate a relatively impoverished view of what mathematics is all about. Both the presence and absence of utterances provide us with information that influences our design of club activities. For more on the nature of the club design process see Graven and Stott (2012). The limited range of responses also contrast with the more elaborated Curriculum Assessment and Policy Statement (CAPS) definition of mathematics, which emphasises that it is a human activity involving processes that “… enhance logical and critical thinking, accuracy and problem solving that will contribute to decision making” (DBE, 2011: 8). Of course learners in Grade 3 would not be expected to elaborate with this type of discourse, but suggestions of connections to real life, problem solving, thinking and so forth would have implied more coherence with the curriculum view of what mathematics is.

The questions that ask the learners to tell us about Mpho and Sam in the mathematics class revealed factors that learners saw as influencing weakness or strength in mathematics. Mostly the learners described Mpho as someone who was disruptive in some way in class for example: “Plays in class” (three learners referred to this), “talks a lot and fights”, “makes a noise, he throws things around the class”, etc. One learner referred to non-participation in writing: “He doesn’t write. He watches other children write.” While one learner, I will call him Jami, explained Mpho as doing the work, but feeling bad due to his weakness: “He writes the mathematics. He feels bad. He does his homework every day.” He also contrasted this to Sam who got everything right, but “does his homework sometimes”. What is communicated in this case is an experience that diligence in doing ones work every day does not necessarily lead to mathematical strength (I will come back to Jami later in this paper when I relate his responses on this instrument to his performance on other instruments). On the other hand, the learners viewed Sam in terms of doing the work he was told to do and writing what was required. For example one learner explained: “He takes everything he needs when the teacher tells him to and he writes all the things she writes and he finishes it.”
Similarly, the ‘complete the sentence’ items relating to Mpho and Sam, being scared of mathematics and loving mathematics respectively “… because …”, provided insight into what learners saw as significant influences on learning experiences. Most of the learners (4/6) in this club answered in terms of getting sums/work right or wrong. For example: “He’s scared he gets everything wrong” for Mpho and “he gets everything right” for Sam. One learner related being scared or loving mathematics to not doing or doing the work: “He doesn’t do the work” and “because he does it every day”, respectively. Contrasting this notion that fear or love of mathematics depends on the extent of work done, one learner related this innate ability by giving the reasons of “being stupid” and “being clever” respectively. The question asking learners if they loved or were scared of mathematics was simply answered in terms of “I love mathematics” or “I like mathematics” or in one case “I am clever”. It is difficult, however, to ascertain the extent to which learners felt compelled to answer this as they were participating in a voluntary mathematics club, which expressly claimed that it aimed to get students to enjoy and love mathematics more.

The final question on the instrument: “What do you do if you don’t know an answer in mathematics class?” possibly provided us with the richest data in terms of understanding a range of possible dispositions across learners in our various clubs. It gave us a sense of the extent of learner independence and the extent to which they saw themselves as mathematical generators, or problem solvers, and the extent to which they viewed their role in the mathematics class as being passive receivers of knowledge and followers of instruction. These are not mutually exclusive as learners can of course perform multiple roles in class, but the instrument allowed us to see which roles were foregrounded. This question helps to distinguish learners who predominantly position themselves as having the agency to solve the ‘unknown’ problem (through for example drawing on their own thinking or methods) from those who position the solution to the unknown as residing with the teacher or someone else, thus indicating less independence in relation to learning dispositions.

In this club all of the six learners suggested asking someone. For example, five of the six learners suggested drawing on the teacher: “Ask your teacher”, “put up your hand and the teacher will explain”, “stick up my hand. Have to wait”, while one learner said “I must ask someone – I’ll ask my friend”. While one might of course expect such answers, and of course in many cases I have given this advice to learners that I have helped with mathematics, the absence of utterances that indicate that one might find a way forward by drawing on one’s own resources is significant. The responses of the learners in this thus contrasts, for example with the much wider range of utterances we received from learners in a different club in a high performing school (in terms of ANA’s and Chair assessments). In this club only two learners suggested asking the teacher and the remaining eight learners referred to ways of solving that did not involve the teacher, e.g. “I thought in my mind”, “I work it out”, “I take scrap paper or counters or my brain”, “stretch my brain a bit and don’t copy.”

The addition of this question about what students do when they don’t know an answer gives rich data that informs club facilitators of club members “ways of being”
(Wenger, 1998) mathematics learners and a sense of the extent to which they have developed a “productive disposition” (Kilpatrick et al., 2001). While it gives insight into this for each learner, it also provides insight into the way in which certain dispositions are promoted across classrooms and schools that we work with in the South African Numeracy Chair. While the case study nature of our club research prevents me from arguing that there may be a causal relationship between learner dispositions and performance on certain mathematical activities, such as problem solving, I would argue that this is an area of research that requires further investigation. Indeed within Kilpatrick et al.’s (2001) five strand definition of mathematical proficiency, productive disposition is intertwined with proficiency in the other strands and in this sense a relationship between them is assumed. However, there is little research that elaborates on the nature of this relationship and how knowledge of learner dispositions might be used to support the design of rich learning opportunities across the strands of proficiency.

The final item on the instrument allowed learners the opportunity to input freely anything they wished to share with the interviewer in relation to mathematics. Since the input was optional, learners tended to decline a response. In this club only one learner volunteered a response to this open item answered “Ek wil net slaag”, which translates as “I just want to pass”.

In terms of our mathematics club focus on developing positive and confident learning dispositions, we embrace learner errors and highlight that they provide rich learning opportunities. We emphasise that there is no shame in not knowing, as we are all learners, and it is because there is always much that we do not know that we come together to learn. Thus emphasising the Socratic philosophy, that it is better to know what you do not know than to think you know, we encourage learners to share and articulate what they do not know.

Additionally, we emphasise the importance of thinking independently and finding ways to solve problems using creative thinking and multiple methods. Think-pair-share is a strategy we use regularly to get learners to begin with independent thinking and their own sense-making, then pairing and sharing encourages engagement, discussion of different methods and argumentation over solutions. The facilitator stimulates discussion and sense-making where necessary, but learners are first encouraged to think independently and then in pairs before drawing on the facilitator for support or acknowledgement.

In our clubs we consider learner mathematical histories rather than work with notions of learner abilities and reject the notion that a learner may be mathematically stupid and instead focus on the ways in which learners learn and their disposition towards learning. This concurs with Askew et al.’s (1997) finding that ‘effective’ numeracy teachers believe that almost all children are able to become numerate, and ensure that all students are challenged and stretched, not just those perceived to be more able. Thus, in this club we would hope that with time learners would begin to provide responses indicating a rich connected understanding of mathematics and
mathematics competence, in terms of the processes and ways in which learners approach and tackle problems, and with regards to their willingness to participate in meaningful engagement in mathematics learning.

Above I have included the data of all six learners on each item of the instrument in order to illuminate what each part of the instrument allows us to see. I have contrasted learner responses with some of the responses in other clubs in some parts, because it is sometimes only by comparison to other possibilities that absences are illuminated and one is able to see that a disposition may be constrained or dependent. While it is not possible in this paper to provide overview stories of each learner in the club across the disposition instrument, and across our other instruments we use to assess procedural fluency, conceptual understanding, adaptive reasoning and strategic competence, it will be useful to elaborate more on Jami (mentioned above) as an example of a story that we are able to glean through our combined instruments at the start of this club. I turn to this briefly in the next section.

Looking at one learner across the instrument and strands

Jami performed poorly on almost all items assessing mathematical proficiency. In Wright et al.’s (2001) terms Jami’s number sense was largely in the ‘perceptual/initial’ stage. That is along the six stages ranging from stage 0 (emergent) to stage 5 (facile) Jami demonstrated mostly stage 1 competences. I conducted the interview and noted that he tried his best on all items, and while he could have opted to say he did not know for some items, he tended to try everything. In Kilpatrick et al.’s (1997) terms he displayed weak procedural fluency, weak conceptual understanding, and almost no strategic competence or adaptive reasoning. After the interview, I discussed his case with our team of interviewers and said that I was struck by his repeated insistence at counting everything in ones. I referred to an item we used from Wright et al. (2001) where we place strips of dots out in front of the learner and asked “how many?” One first places a strip of dots with four dots, then one adds another strip of dots with 10 dots and asks, “now how many?” One continues to add strips of ten and asking “now how many?” until there are 74 dots altogether.

I was amazed that Jami continually went back to counting from the beginning of the four dot strip each time I asked, “now how many?” and counted all the dots in 1s touching each one as he counted. Many learners that I have conducted this interview with, who begin by counting in ones for the first few questions, usually progress to adding in tens or counting on from the previous answer at some point in the questioning process. I considered that the learner did not do this, even though I suspected he was capable of figuring this out as a more efficient method during the interview process, because he did not believe he had the freedom to depart from the concrete method within the school context. I suspected that he thought the required method for doing this type of problem was to show one’s counting from the beginning and to convince the teacher or adult by touching each dot as one counted. I got the sense that unless he was told to count ‘in tens’ or to ‘count on’ it
would not occur to him that this was ‘allowed’. He smiled at me with a deep breath before embarking on touching and counting all seventy four dots in the final question. At present this research has not focused on the influence of classroom teaching on learner dispositions, but I see this as an important avenue that requires exploration.

Jami’s seemingly restricted learning disposition that involved doing what one believed was required, rather than experiencing the freedom to draw on one’s own sense-making, and actively generating the direction of one’s learning through creative decisions in the process of doing mathematics haunted me for several days as I suspected that Jami’s hard working, compliant and willingness to please disposition were, ironically, most likely restricting his progress. This concurred with his response on the learning disposition instrument when he indicated in response to what he does if he does not know an answer that he would “... stick my hand up. Have to wait”. This relatively passive teacher dependent learning disposition will more than likely stifle his progress in mathematical sense making.

Indeed he may fear finding his own solution in case it departs from the teachers. It seems Jami is somewhat aware that his hard work might not result in success as his utterances describing Mpho indicated that Mpho felt bad despite writing the mathematics and doing his homework everyday (discussed above). For the “mathematics is ...” item Jami simply responded “sums”, and for “Do you love mathematics” he watered it down with “I like mathematics”.

I would argue that the instruments give us a picture of how Jami’s disposition is intertwined with his mathematical performance on the other strands and indicates ways in which we need to support Jami in strengthening his mathematical proficiency. I would argue that it is important that as club facilitators we find ways to shift Jami’s restricted learning disposition to one which more confidently explores his personal sense-making and methods. Without this I suspect that his belief that ‘hard work’ and doing homework does not necessarily pay off might in time result in non-participation. This was evidenced in earlier research with mathematical literacy learners who told stories of non-participation, as a result of experiences that hard work and effort did not lead to sense making, and thus did not pay off (cf. Graven & Buytenhuys, 2011).

**Conclusion**

A key aim of our setting up of mathematics clubs is to interrupt what we perceive to be a passive overly teacher dependent culture of learning mathematics. We hope to interrupt notions that mathematics learning must be teacher led or initiated by a clear teacher method or instruction. We wish to de-emphasise current motivations for mathematics participation that are seemingly dominated by compliance with teacher instructions and getting answers right. We hope to supplement this with engendering a motivation that is more intrinsic to the process of learning and to reveal that the gains of mathematical sense-making and learning include both personal development and mathematically capable participation in society, more generally. We hope to
engender a love of challenging oneself mathematically and learning mathematics for solving problems in creative ways both in, and outside of, school.

We wish to develop learners, in keeping with the new curriculum, who have:

- critical awareness of how mathematical relationships are used in social, environmental, cultural and economic relations;
- the confidence and competence to deal with any mathematical situation without being hindered by fear of mathematics;
- a spirit of curiosity and a love of mathematics; appreciation of the beauty and elegance of mathematics; recognition that mathematics is a creative part of human activity;
- a deep conceptual understanding in order to make sense of mathematics; and
- the acquisition of specific knowledge and skills necessary for:
  - the application of mathematics to physical, social and mathematical problems;
  - the study of related subject matter (e.g. other subjects); and
  - further study in mathematics (DoE, 2011: 8).

Additionally we hope that our research in clubs might feed back into classrooms ways in which teachers might support learners in nurturing such dispositions.

It would seem from this early data of the six learners participating in this club that notions of compliance dominate at the expense of the achievement of these broader aims of mathematics as a subject in the foundation phase. Learners view teacher dependence and compliance as key to their success and while this has a place in learning it cannot overshadow the need to develop learners capable of independent, critical and creative thinking, which are important for developing all five strands of mathematical proficiency. Additionally such thinking is required for participation in society and democratic citizenship.

A hypothesis might be that learners with learning dispositions that are overly compliant and teacher dependent would be less likely to develop strength in the strands of conceptual understanding, strategic competence and adaptive reasoning as these require, by their definition, learners to make sense of mathematics and to think critically and creatively. While this makes intuitive sense, and resonates with my own teaching experience, larger scale research is required to explore the complexity of the relationship between this strand and others. The broader research across the clubs in the South African Numeracy Chair will explore this relationship further.

**Acknowledgement**

I thank the team of researchers within the South African Numeracy Chair, Rhodes University for their on-going collaboration and particularly Debbie Stott with whom I
am working closely with to research learning within our mathematics clubs. The work of the South African Numeracy Chair, Rhodes University is supported by the FirstRand Foundation (with the RMB), Anglo American Chairman’s fund, the Department of Science and Technology and the National Research Foundation.

**Endnote**

1. Professor Adler at the FirstRand Mathematics Education Chair Community of Practice forum held in Cape Town (30/11/2010) argued in her presentation that we have to ‘interrupt’ the learning and teaching culture in schools where learners are passive, learning is teacher dependent and the focus of teaching is on ‘compliance’.

**References**


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Teaching natural science in the foundation phase: Teachers’ understanding of the natural science curriculum

Abstract
This study explores foundation phase teachers’ understanding of the natural science curriculum within the life skills learning programme. The theoretical framework for this study is entrenched in the relationship between the intended and the implemented curriculum. The Zone of Feasible Innovation (ZFI) is the proposed theory of implementation and states that implementation of the intended curriculum is very difficult if teachers do not have the capacity to implement it. The study seeks to determine where teachers are operating within their ZFI. Data was collected through questionnaires, interviews as well as a rating scale for teachers. The findings show that teachers are confident to teach content that they have been teaching for a long time, but are reluctant to introduce new science topics or new methods of instruction. This reluctance impacts on their ability to implement new innovations in science teaching. However, there are signs that their ZFI has progressed to include certain new practices.

Keywords: curriculum implementation; capacity to innovate; profile of implementation and zone of feasible innovation.
Introduction

Recent developments in South Africa echo worldwide transformation trends in science education. In the United Kingdom Target 1 for science in the National Curriculum has apportioned much precedence to scientific investigations (Department of Education and Employment, 1999). In the United States, the American Association for the Advancement of Science (AAAS) and the National Research Council (NRC) sanction science curricula that actively engage learners using an inquiry based approach. (American Association for the Advancement of Science, 1993 and National Research Council, 1996). The New Zealand Curriculum Framework maintains that science is essential to understanding our world and active participation in science fosters understanding (New Zealand Ministry of Education, 2009).

Science and its related fields of study are viewed as a scarce skill in South Africa. According to Boshoff and Mouton (2003: 231) –

... there appears to be a gradual ageing of the publishing scientific workforce with a low level of new entrants into the science system (especially natural science).

Braund and Reiss (2006: 1373) recognise the problem exists in many developed countries of the world as well, where fewer learners are choosing to study science at higher levels and as a career. Our contention is that the solution to increasing the number of science graduates lies within the school system. This can only be achieved if learners have an interest in the subject and if that interest is nurtured during the early years of schooling. This interest and love for science has to be developed and nurtured from the time the child enters the schooling system in Grade R. This is necessary, not only to make daily decisions but also to meet the demands of the global economy.

According to the Revised National Curriculum Statements (RNCS) (DoE, 2003: 4), the natural science learning area deals with the promotion of scientific literacy. This is achieved by developing and using –

... science process skills, critical thinking skills and problem-solving skills in a variety of settings, developing and applying scientific knowledge and understanding and appreciating the relationships and responsibilities between science, society and the environment (DoE 2003: 4).

The RNCS also maintains that the natural science learning area must be able to provide a foundation on which learners can build throughout life.

At the foundation phase level, the curriculum consists of three learning programmes, namely literacy, numeracy, and life skills. This study was conceptualised while the RNCS (DoE, 2003) was the official policy document with the result that reference is still made to “learning outcomes and assessment standards”. The Curriculum and Assessment Policy Statement (CAPS) came into effect in January 2012. This document attempts to facilitate interpretation of the National Curriculum Statement (NCS) and does so by removing notions of ‘learning outcomes’, ‘assessment standards’ and ‘learning programmes’ from the curriculum. The implications for the foundation phase are the consolidation of six learning areas into study areas under the
umbrella of ‘life skills’ as a curriculum component (DoE, 2011: 5). In this configuration ‘natural science’, as a learning area, is included as a component of ‘Beginning Knowledge’. While this may appear to be a major change, the fact is that emphasis in science learning is still on inquiry learning and problem solving, with limited formalised conceptual learning. In both the RNCS and the CAPS the weekly allocation for science is quite limited making this study as relevant now as it was when it was conceptualised.

In the foundation phase, natural science has not traditionally been seen as a focus of instruction. Many reasons could be attributed to this: having no specific curriculum for teachers to follow, teachers’ lack of content knowledge, the issue of unavailability of resources, large class sizes, teacher identity and teacher confidence are some of the reasons that could be offered. Other problems that may well contribute to this could be the background of the teachers and the fact that science is integrated in the life skills learning programme. Although the RNCS (DoE, 2003) has natural science as a mandatory component of the life skills learning programme, it fails to clearly define how scientific investigations can be integrated within the foundation phase classroom.

Our experiences during the professional practice of student teachers made us aware of the fact that natural science was not a priority area in the foundation phase. In fact, student teachers were often adamant that natural science is not taught in the foundation phase. When visiting student teachers during the professional practice we observed them teaching science lessons in the way they were instructed to do so by their mentor teachers. Our experience of working with foundation phase school teachers confirms this. Teachers were heard to say:

The basic thing in our school is mathematics and literacy [...] no one speaks of science [...] science can be rowdy [...] it is neglected but what can we do ...

This prompted this study, as we were curious to find out how natural science is conceptualised by foundation phase teachers.

The research questions, which guided the study, are:

• What are foundation phase teachers’ understandings of the natural science curriculum?
• How do teachers’ understandings of natural science influence their ability to implement a transformational curriculum?

**Review of related literature**

Appleton claims that primary teachers are normally hesitant to teach science (2008). He cites two reasons for this, the first being a limited knowledge of science content as well as a limited science pedagogical content knowledge (PCK) (Appleton, 2008; 2003). Studies that consistently reveal problems with primary science education are a manifestation of the science knowledge held by primary school teachers (Scholtz, Watson & Amosun, 2004; Sherman & MacDonald, 2007). The natural science curriculum for the foundation phase emphasises ‘investigations’ as the most important learning
outcome. Consequently, at foundation phase level there is only one learning outcome, which states that the –

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts (DoE, 2003: 6).

Appleton’s (2008: 525) study of a professional development programme revealed that elementary or primary school teachers work with pedagogical content knowledge (PCK) in different ways when compared to secondary school teachers. Primary school science teachers usually start with the idea that science teaching should be activity-based and work from specific activity ideas. He goes on to explain it is not surprising that the majority of primary school teachers tend to have limited knowledge in both science content knowledge and in science PCK, given that few primary school teachers are science discipline specialists. foundation phase teachers may lack confidence in their abilities to teach science because of incomplete content knowledge (Akerson & Flaningan, 2000; Borko, 1993; Smith & Neale, 1989). Those lacking confidence tend to engage in avoidance behaviour, such as not teaching science at all or teaching a version of science that more closely resembles such subjects as language and social studies (Appleton, 2008: 525).

While foundation phase teachers in the South African context are not required to teach science content to learners, teachers need adequate content knowledge to facilitate inquiry learning. A study conducted by Cho, Kim and Choi (2003) on early childhood teachers’ attitude to science teaching revealed that “science teaching in early childhood education usually does not require much content knowledge of science”. They go on to say: “What early childhood teachers need is not the knowledge, but rather practical approaches that correspond to young children’s characteristics” (Cho, Kim & Choi, 2003: 39). Yilmaz-Tuzun (2008: 188) further elaborates, “... teachers content knowledge can influence what they teach as well as how they teach.” It has been reported that –

... teachers who lack content knowledge often resort to lecture instead of using learner centred teaching techniques that produce real student understanding (Grossman, Wilson, & Shulman, 1989: 27).

Yilmaz-Tuzun (2008: 197) concludes from his study that if –

... teachers know the content well it will be easier for them to choose the appropriate pedagogical activities and teaching methods.

Other reasons given for the marginalisation of science in schools are school contextual factors, such as limited resources for teaching science and perceived priorities in primary schooling afforded to other subjects as compared to science (Appleton, 2003). These reasons are also inherent in South Africa’s education system. Currently there is a strong move towards improving basic reading, writing and mathematical skills. As a result, the time spent teaching science especially in the foundation phase has been reduced. Limited resources are a reality in our schools. In the foundation phase, natural science forms a one sixth part of one of the three learning areas, namely life skills. The very idea that natural science has to be integrated within the
life skills learning programme, which in turn has to be integrated in the foundation phase curriculum, which includes numeracy and literacy, is a source of uncertainty and confusion for teachers.

Foundation phase teachers are viewed as having a specialised body of knowledge which includes knowledge about children, teaching, learning and the curriculum that can be translated into meaningful practice. The teacher must plan learning experiences that engage and challenge children in thinking that is conceptually rich, coherently organised, and persistently knowledge building. An effective foundation phase teacher is going to be one who can facilitate and extend children’s learning within the holistic nature of the early childhood curriculum without being overcome by the conventional notions of teaching. In the curriculum area of science, this is particularly difficult since teachers often do not have the requisite background knowledge to integrate content and pedagogy on their own.

Henze, Van Driel and Verloop (2007) claim that teachers’ knowledge, determines to a large extent, how they respond to educational innovation. It is, for this reason, necessary for innovators to take this knowledge into account when implementing educational changes. These authors investigated how teachers’ pedagogic practices changed in response to a curriculum innovation and what factors affected the ways in which they changed. They explored how physical and social factors interacted with aspects of teachers’ own personal histories, such as their experience and training for teaching science, and how these factors affected how they adopted or adapted the curriculum innovation. They concluded that teachers’ knowledge will transform steadily over time –

... due to new experiences, in addition, to improve successful implementation high quality teaching materials needs to be applied (Henze, Van Driel & Verloop, 2007: 120).

From the literature review, it is apparent that various factors influence the way a teacher will approach implementing the natural science curriculum.

Theoretical framework

Teachers’ are expected to teach natural science in an integrated life skills programme by focusing on an inquiry-based, problem-solving approach. The extent to which they are able to do this, depends on their understanding of the curriculum which, in turn, will influence the way they implement the curriculum. Rogan and Grayson (2003) maintain that for curriculum change to occur, both the ‘why’ (the need for curriculum change) and the ‘how’ (issues pertaining to the implementation) must be addressed. To accomplish this they suggest a theory of implementation called the Zone of Feasible Innovation (ZFI).

The ZFI is based on Vygotsky’s notion of a zone of proximal development (ZPD) (Rogan & Grayson, 2003: 1195). Analogically this ‘zone’ is what can be learnt with effective mediation. The ZPD can thus be seen, by way of analogical reasoning in this metaphor, as the (conceptual) ‘distance’ between the actual development level as
determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers (Vygotsky, 1998). The ZFI is, in the same form of analogical reasoning, the ‘distance’ between the actual capacity of the teacher with regard to implementation of a new curriculum and the degree of innovation required by a new curriculum. As with the idea of the ZPD, context is an important factor in determining the complexity of innovation. While curriculum is defined at a macro-level (DoE, 2003), the ZFI is designed to operate at a micro-level. The ‘zone of feasible innovation’ remains a hypothetical construct in analogical reasoning, which suggests that innovation should not exceed current practice by too large a gap between existing practice and the demands of the innovation, lest the teacher is stretched too rapidly (cf Figure 1).

<table>
<thead>
<tr>
<th>ZFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current routine practices, e.g. demonstrations</td>
</tr>
</tbody>
</table>

**Figure 1:** The location of ZFI.

This theory of implementation, according to Rogan and Grayson (2003: 1178) is based on three major constructs, namely 1) *profile of implementation*, 2) *capacity to support implementation* and 3) *support from outside agencies*. The third construct, support from outside agencies was not addressed in this study which focuses on the teacher and not the curriculum. The profile of implementation is an attempt to comprehend and articulate the degree to which the principles of a set of curriculum proposals are being put into practice. For the purposes of this study, the probable dimensions of the profile of implementation reported on pertain to the teacher only.

The construct, *the capacity to support innovation* entails the endeavour to comprehend and extend on the factors that are able to sustain, or hamper the implementation of new ideas and practices in a system as a school (Rogan & Grayson 2003: 1186). Not all schools have the ability to execute a given innovation to the same degree. For the purpose of this study, the focus is only on teacher factors as the capacity to support innovation.

A framework for this study was developed by adapting the theory of implementation proposed by Rogan and Grayson (2003).
Research design and methodology

A qualitative research design was employed for the purpose of this study, to provide rich descriptions of phenomena under investigation. The style of educational research adopted for this research was a case study. This research initiative used an interpretive methodology in an attempt to comprehend teachers’ understanding and implementation of the natural science curriculum in the foundation phase.

In order to obtain data, four foundation phase teachers from Grade R to 3 in one school participated in the study. The research site for this study was an urban school in the greater Durban area. This was historically a school for coloured learners. The learner population is made up of predominantly coloured and African learners. This site was chosen for the study as it is a public school that has Grade R as well as Grades 1, 2 and 3.

Data collection

Data was obtained from the questionnaire, semi-structured interviews and a rating scale. The questionnaire supplied data on teachers’ content knowledge and instructional methods, as well as teachers’ levels of confidence. The interviews served to elaborate on responses obtained from the questionnaire. The questions pertaining to content knowledge and instructional methods were informed by the expectations of the RNCS. An addendum to the questionnaire provided clarification of each instructional method, which was formulated by consulting various sources so that...
there was a common understanding of what was meant by each instructional method (O’Bannon, 2002; Sidhu, 2006; Thomas, 2000).

The rating scale (cf. Appendix A) used in this study was obtained from Cho, Kim and Choi (2003) who developed the scale to measure early childhood teachers’ attitude towards science teaching. Although the scale was adapted to be appropriate for this study, the core structure was retained. The rating scale was designed around four sub constructs with a sum of 34 items. The first sub construct had ten items, which measured teachers’ confidence in teaching science content. The second sub construct measured teachers’ classroom preparation and had 13 items. The third sub construct had six items to measure how teachers’ manage ‘hands on’ science. The fourth sub-construct measured the developmental appropriateness of the science curriculum as perceived by the teachers. Teachers responded to the 25 positive and nine negative items using the three-point Likert Scale from agree to disagree.

In qualitative research, claims of validity rest on the data collection and analysis techniques. To enhance validity in this study a multi-method strategy and mechanically recorded data were used. Multi-method strategies allowed for the triangulation of data across inquiry techniques (Struwig & Stead, 2004; McMillan & Schumacher, 2001). Informed consent was obtained from the participants in the research during the planning of the study (Brickhouse, 1992). Permission to conduct research was obtained from various stakeholders and the University of KwaZulu-Natal gave ethical clearance for the research to be conducted.

The teachers
The four teachers in the study are all females and will hereafter be referred to as Karen, Fiona, Carly and Simone (pseudonyms).

- **Karen** has 35 years’ experience teaching in the foundation phase. She has 38 learners in her Grade R class. She has a three-year Lower Primary Teaching Certificate. She studied Biology at school and the teacher qualification had a general science component. Being 58 years of age she is the oldest participant. She believes that her experiences best qualifies her as a foundation phase teacher. Since there is only one Grade R class, she has to complete all the planning and preparation on her own.

- **Fiona** has 17 years teaching experience of which 13 years has been in the foundation phase. She has a three-year teaching qualification from a teaching college. She has 47 learners in her Grade one class. She is 44 years old. She sees the benefit of her teaching qualification because in her last year of study she majored in the foundation phase. She has had experience making teaching aids as well making science equipment. She is very confident in her knowledge of the curriculum documents, “I know all my LO’s (learning outcomes) in each learning programme and am able to integrate the different learning areas.”
• Carly has 10 years teaching experience of which eight years has been in the foundation phase. She has 44 learners in her Grade two class. She was the youngest teacher. She is 34 years old. She has a four-year qualification and is currently studying towards the Advanced Certificate in Education (ACE). None of her teacher qualifications had a science component. She believes that the workshops she attended on phonics and reading has improved her teaching.

• Simone has 21 years teaching experience of which 20 years has been in the foundation phase. She has 44 learners in her Grade 3 class. She is 43 years old and has a four-year teaching qualification. Simone is of the opinion that –

... having my fourth year ACE and learning integrated education using computers has thoroughly equipped me to teach my learners using computers to do research on the computer. Learners somehow do amazing work when using technology.

Findings
The findings from the questionnaires are presented in three tables, two of which relate to teachers’ understanding of natural science while the third table presents evidence of teachers’ confidence levels in teaching natural science. By understanding we mean teachers’ views of what should be taught and how it should be taught. Table 1 shows the number of content areas out of 20 topics in the natural science curriculum that each teacher was either, very confident, confident, not so confident and not confident to teach. Where there are no ticks (✓), there were no responses to that content area. The teachers’ responses were tallied.

Table 1: The content areas that teachers were confident teaching.

<table>
<thead>
<tr>
<th>Content knowledge</th>
<th>Very Confident</th>
<th>Confident</th>
<th>Not so confident</th>
<th>Not confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td>R 1 2 3</td>
<td>R 1 2 3</td>
<td>R 1 2 3</td>
<td>R 1 2 3</td>
</tr>
<tr>
<td>Light energy and colour</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Heat energy</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sound energy</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Magnetic interactions</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Electrical energy</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Simple machines</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Plants</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Animals</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Nutrition</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Air</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Weather</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Water</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Matter and materials</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Table 1 indicates a noticeable trend in the content areas teachers were confident to teach. These areas were plants, nutrition, air, weather, water and human body systems. They seemed mostly confident teaching biology-related topics rather than physical science-related topics. Teaching these content areas to learners in the foundation phase might seem natural and innate as the natural environment could be used as resource. Therefore, it is surprising that teachers were not confident to teach Ecology. Having studied Biology at school it would seem that Karen and Fiona could have used this knowledge to contribute to their confidence in these content areas. All of the common content areas, except for plants, form part of the Beginning Knowledge in the CAPS documents (DoE, 2011). Environmental awareness forms part of the curriculum from Grade R to 3. Teachers’ responses in the interviews provide reasons for teaching only particular content topics:

Karen: It is part of the school curriculum. These topics are taught across the grades yearly.
Fiona: Because we teach this. Not confident in the others because maybe we don’t teach them.
Carly: It seems to come up a lot depending on our context sometimes it does fall in our context, in our lesson planning.
Simone: We teach this as part of our curriculum.

In addition, there seems to be a relationship between the science content not taught and the teachers’ confidence as reflected in their responses:

Karen: Inappropriate to my grade R curriculum. Not part of our curriculum.
Fiona: Most of those that I am not confident.
Carly: I am not really [...] actually I don’t have the (pause) [...] how can I put it the knowledge. I don’t know much with these areas. It also has not been part of our planning.

Simone: Not relevant to the curriculum for Grade 3.

There does not seem to be much change in the basic content areas from year to year, although the content is rotated between the grades. Fiona said:

We change content every year. Like if we teach animals, we could do pets and the next year we could do wild animals. That’s how it works in the foundation phase. If we teach pets, Grade 2 will teach wild animals and Grade 3 will teach care of pets and wild animals. And we will swap. Grades 3’s tie it up.

Whether this confidence is due to the fact that they have taught these topics over many years or whether they select topics to teach that they are confident to teach, is not clear. If the second reason applies, teachers will be reluctant to start teaching new topics and this limits their ability to teach across a range of topics, including those topics that may be taught using an investigative approach. Their argument that it is in the curriculum does not hold, as the curriculum is not that limited. It seems as if this particular group of teachers have selected certain topics and constructed their lessons around it. They have in a sense designed their own curriculum to suit their context and their abilities.

Table 2 shows the frequency of the different instructional methods the teachers use to teach science. The teachers’ responses were tallied.

The frequency of the instructional methods reveals the manner in which teachers believe natural science should be taught and is an outcome of their understanding of natural science. The common instructional method used by all teachers is discussion. Discussion is a passive process where the learners are usually seated and are not actively involved in the learning process. Teachers seem to believe that discussions “stimulate learners thinking and imagination” and “bring out the knowledge”.

‘Hands on’ was the next instructional method that was used by all teachers. This suggests that teachers do believe that learners need to be actively involved in learning. From the interviews teachers explained that they do hands on activities, because “they (the learners) must experience it”. From the rating scales completed by the teachers, they all agreed that they did not mind the messiness created when doing ‘hands on’ science and that they are comfortable using any classroom materials for science activities. The instructional methods not used were inquiry, scientific investigations, laboratory and graphic organisers. According to the RNCS there is only one learning outcome in the foundation phase, which is Scientific Investigations (DoE, 2003). The teacher’s guide for the development of learning programmes realises that there needs to be transformation in the pedagogy of science teaching and suggests the transformation be “characterised by investigations being placed at the centre of all classroom activities” (DoE, 2003: 27). It is understandable that teachers did not use a laboratory as the school does not have one.
Table 2: Frequency of instructional methods used by each teacher.

<table>
<thead>
<tr>
<th>Instructional Methods</th>
<th>Grade</th>
<th>Daily</th>
<th>Weekly</th>
<th>Fortnightly</th>
<th>Monthly</th>
<th>Once a term</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquiry</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lecture</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demonstration</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discussion</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Role playing</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem-based learning</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooperative learning</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discovery</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific investigations</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem solving</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>‘Hands-on’</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Journal</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning centres</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scaffolding</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simulations</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case studies</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphic Organisers</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stories/narrative</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>20</td>
<td>10</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>
Evidence from the rating scales suggest that two out of the four teachers (Karen and Carly) feel they have the necessary skills to teach science and are comfortable doing science activities; the other two teachers (Fiona and Simone) are undecided. Three out of the four teachers (Karen, Fiona and Carly) fear science activities would not turn out as expected and they have a difficult time understanding science although they enjoy it. All the teachers agree that they are able to answer learners’ science questions and when they teach science they welcome learners’ questions. Teachers’ choice of instructional methods fit the curriculum as determined by the teachers. If teachers are not willing or able to introduce topics that lend themselves to inquiry learning, there is little chance that this will happen.

When teachers were asked whether their learners would be able to conduct investigations, there was a common thread in their responses:

- Karen: I think so. They will love that.
- Fiona: Absolutely, Absolutely, Absolutely!
- Carly: Not all of them. Depending on their levels, they are at because they are all at different levels. The bright children, maybe a third of them will be able to, but the middle group will be able to, but they won’t be so sufficient like the first group. The last group really struggles.
- Simone: No. No they would, with guidance. They are very eager and they are willing to learn. They are like sponges they suck up anything.

The teachers did believe that their learners were capable of carrying out investigations and yet none of them selected scientific investigations as an instructional method for teaching science. It was only Carly who thought that only her ‘bright’ learners would be able to carry out investigations.

Teachers were asked to identify the characteristics that best describes them as a foundation phase teacher teaching natural science. The characteristics, included dedication, caring, well qualified, experience, attends professional development activities, confidence, approachable, tries innovative teaching techniques, plans lessons well, sound science content knowledge, conscientious attendance, competent and sound science pedagogical content knowledge. From the data, it is evident that the teachers have a very good image of themselves. Out of the 15 characteristics, the only two that all teachers did describe themselves as not having were sound “science content knowledge” and “sound science pedagogical content knowledge”. Fiona was the only teacher that represented herself as having all the characteristics. Teachers commented on their choice of characteristics that best describes them:

- Karen: Experience and been at it for so long.
- Fiona: You have to be well qualified although I am not well qualified but I think dedication comes in there as well and the willingness to constantly keep abreast with new educational issues and learning materials. Science content knowledge is absolutely necessary. You must have sound knowledge and to an extent I know the degree of complexity changes from Grade One in comparison to high school but my knowledge must
at least [...] for although it is limited for the grade ones I must know what I am talking about.

Carly:  All except sound science content knowledge and sound science pedagogical (teaching) content knowledge. Maybe I still need more practice in the science field. Not that I can’t – I think I just need to get more knowledge.

Simone:  I would like to improve my science content knowledge as I am not confident in this learning area, however, I do try to do my best.

None of the participants see natural science as their greatest strength, nor do they see lack of science knowledge as a great weakness for a foundation phase teacher. Only one teacher suggested “She neglects life skills”. The two factors that teachers are least confident in are two crucial factors as they determine the teacher’s capacity to implement innovative curriculum changes and teach to those changes.

**Discussion and conclusion**

The purpose of this study was to gain insight into foundation phase teachers’ understanding of their natural science foundation phase curriculum. Teachers’ understanding of science will influence their capacity to implement innovative curriculum changes.

A relationship exists between teachers’ choice of content and their confidence to teach the content. The content taught by these teachers is content that they have been engaging with for many years. Although teacher knowledge is correlated to –

... individual experiences and circumstances, there are features, which are shared by groups of teachers who are in similar situations (Henze, Van Driel, & Verloop, 2007: 102).

In this study, the group of teachers are in the same school and in the same foundation phase department. Their understanding of natural science appears to be limited as they believe they are teaching all that the curriculum requires of them. They do not appear to consider the possibilities of introducing different topics into the curriculum. The fact that they work and plan together is commendable, but it does seem to hamper their inclination to be more innovative as they are all very comfortable with the status quo. Their planning is done together hence they are knowledgeable and confident in the same content areas. The capacity to support a new curriculum is dependent on a number of factors; teachers competence being one of them. This study shows that one of the teacher factors, i.e. content knowledge, is not strong and this restricts the teachers’ ability to implement innovative curriculum changes.

With regard to the profile of implementation, teachers’ use of instructional methods to teach science is not indicative of an inquiry-based approach to teaching science and especially scientific investigations, which is the only natural science outcome in the foundation phase. However, teachers do believe that their learners are able to conduct investigations and a ‘hands on’ approach to teaching science should
be encouraged. If teachers had confidence to teach more content areas then they may develop the competence to select suitable instructional methods that promote inquiry. Studies have shown that knowledge of content to teach will make it easier for teachers to choose the most appropriate instructional method (Shulman, 1986; Yilmaz-Tuzun, 2008). Teachers are influenced to teach science in the manner that they do, because of their limited experience of teaching science. These teachers are not science specialists, but received their training as foundation phase teachers. Although they see the value of science and know that ‘hands-on’ methods of inquiry should be promoted they do not have the content knowledge to implement it.

Considering the profile of implementation with regard to natural science teaching, as well as the teachers’ capacity to innovate the curriculum, the question arises where these teachers are situated within the ZFI? Are they moving towards ‘ideal practice’ and how far are they from ‘ideal practice’? Answers to the research questions give us some indication of where these teachers may be: They do not have a broad spectrum of science content knowledge and this influences their instructional practices. While they are willing to try ‘hands-on’ activities, their ZFI is closer to traditional discussion practices than to innovative scientific investigative approaches.

Suitably designed teacher in-service training that focuses science teaching at foundation phase level may contribute to increasing teachers’ confidence in teaching science. Subject content knowledge, instructional methods and the integration of natural science in the foundation phase learning programmes should form part of the in-service training. Appleton (2003: 18) reports that “Teacher education programmes have also received criticism for not preparing teachers adequately.” The enthusiasm and confidence with which these teachers appear to approach science teaching is encouraging. Increasing confidence through improved science knowledge may lead to more appropriate instructional methods which would enable them to expand their ZFI. In the South African context, where teachers have been subjected to considerable curriculum change, defining the ZFI in different contexts may serve and important purpose in assisting teachers to cope with such changes.

References


Appendix A

**Rating Scale:** Teaching natural science in the foundation phase: Teachers’ understanding of the natural science curriculum.

<table>
<thead>
<tr>
<th>Items</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have the necessary skills to teach science.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel comfortable doing science activities in my classroom.</td>
<td></td>
<td></td>
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<tr>
<td>I fear science activities would not turn out as expected.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I understand science concepts well enough to effectively teach science.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I find it difficult to explain to learners some science concepts.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am typically able to answer learners’ science questions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Given a choice, I would not invite the principal/head of department to evaluate my science teaching.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have a difficult time understanding science.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I enjoy teaching science.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>I am typically able to answer learners’ science questions.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Given a choice, I would not invite the principal/head of department to evaluate my science teaching.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have a difficult time understanding science.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I enjoy teaching science.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When teaching science, I usually welcome student questions.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Classroom preparation</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>I enjoy reading resource books to obtain ideas about science activities for young children.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am willing to spend time setting up materials for scientific exploration.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>I am happy to help children construct science equipment for hands-on science.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teaching science takes too much time.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am ready to learn and use scientific knowledge and skills for planning hands on science.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like to discuss ideas and issues of science teaching with my colleagues.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teaching science takes too much effort.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am familiar with raising open-ended questions to encouraging children’s scientific exploration.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I use many hands-on activities to help my learners learn science.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Items</td>
<td>Agree</td>
<td>Undecided</td>
<td>Disagree</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------</td>
<td>-----------</td>
<td>----------</td>
</tr>
<tr>
<td>I am able to take my learners outside the classroom to learn science.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparation for science teaching generally takes more time than other subject areas.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Classroom preparation**

<table>
<thead>
<tr>
<th>Items</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I integrate science into other subject areas.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I integrate other subject areas into science.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Managing ‘hands-on’ science**

<table>
<thead>
<tr>
<th>Items</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am not afraid of demonstrating experimental procedures in the classroom</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I enjoy collecting materials and objects to use in my science teaching.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am interested in handling certain animals and insects to teach science.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am comfortable using any classroom materials (e.g., blocks, toys, boxes, etc.) for science activities.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do not mind the messiness created when doing hands-on science in my classroom.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teaching of science process is important.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Developmental appropriateness**

<table>
<thead>
<tr>
<th>Items</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I do not believe it is appropriate to introduce science to children at an early age.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am comfortable with determining the science curriculum that is developmentally appropriate for young children.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I do not feel that young children are curious about scientific concepts and phenomena</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am familiar with the processes and ways that young children learn science.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel that young children cannot learn science until they are able to read.</td>
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</tbody>
</table>
Learning and teaching natural science in the early years: A case study of three different contexts

Abstract
Currently many children in early childhood education cannot be accommodated in provincial department schools. Consequently, different non-governmental institutions offer Grade R programmes in an attempt to support the DBE. Pre-primary schools that traditionally took responsibility for early childhood education also offer Grade R education. The recent policy decision to include Grade R in the primary school is an innovation, which is still in its infancy. It is against this background that the national South African Curriculum (NCS) has to be implemented. This paper focuses on the teaching of natural science in Grade R and attempts to determine if the teaching and learning of natural science has different outcomes in the different contexts described above. An oral questionnaire was administered to capture children’s understanding of natural science phenomena, while interviews provided data with regard to teachers’ understanding of natural science in the foundation phase. The results show that there are differences in children’s understanding of natural phenomena in the different contexts and these differences are related to teachers’ understanding of the curriculum, as well as their views of the nature of science.

Keywords: Grade R; science teaching; process skills; teachers’ understanding of science.
Introduction

Early Childhood Development (ECD) is a broad term that includes reference to the policies and practices that focus on the development of children from birth to nine years of age. According to an earlier document from the Department of Education, White Paper Five, the Education and Training Policy document (2001: 9) –

... early childhood development is an umbrella term that applies to the processes by which children from birth to at least nine years grow and thrive, physically, mentally, emotionally, spiritually, morally and socially.

The development of young children is viewed in a holistic manner in that all the human facets are considered, but rather counter intuitively, the cognitive development of children is not viewed as primary. The influences of all the aspects on the development of a child are given a primary view.

In many countries the provision of primary education during the early years is recognised as a right for all citizens. The World Declaration on the Survival, Protection and Development of Children, agreed to by many nations at the World Summit of Children in 1990, focused on the rights of children “to give every child a better future” (United Nations Committee on Education, 1990: 1). The early years for children are critical for their development later on in life. According to the White Paper Five policy document –

With quality ECD provision in South Africa, educational efficiency would improve as children would acquire the basic concepts, skills and attitudes required for successful learning and development (White Paper Five, 2001: 8).

Essentially, all the above-mentioned policies were concerned with an integrated approach to the cognitive, social, emotional and psycho-social development of children (Education White Paper, 2001).

In South Africa the Bill of Rights in our Constitution, Act 108, Section 29 (1)(a), (Republic of South Africa, 1996) stipulates that –

... everyone has the right to a basic education, including adult basic education; and further education, which the State, through reasonable measures, must make progressively available and accessible.

These policies are significant in bringing attention to the importance of education for all citizens, especially young children. A further requirement that all young children should have access to education of equal quality has encountered many challenges. Further challenges are highlighted in the “Education for All” policy document (Department of Basic Education, 2010), in that, the early childhood development phase crosses a number of different departments, as there are various aspects that need to be considered, such as the welfare of children and the health of children. However, the role of the national Department of Education (DoE) cannot be ignored or subsumed. It has the responsibility of increasing access to education for young children, especially those from rural areas, by establishing appropriate ECD sites (DoE, 2006).
Currently, many facilities that cater for children in the pre-formal schooling phase (including Grade R) are run by non-governmental agencies. While the intention of the department of education, in the early post 1994 years, may have been to bring all such facilities under its control, this was not feasible. According to Biersteker (2010: 13), “the primary site of intervention is the home and a range of programmes will be needed to reach all children especially the majority who are poor and vulnerable”. What we have today, as a result, are many centre-based (formal) services that serve about 20% of the children younger than five years (Biersteker, 2010: 15). Certain facilities are not formally part of the DoE, but are subsidised by it, while others receive no such support. Such subsidies are usually inadequate and these facilities depend on the community for additional funding. This, of course, perpetuates inequities of the past as poor communities are less able to provide adequate finances and children from such communities lack the necessary facilities required to prepare them for formal schooling. KwaZulu-Natal, with its high population, has many such facilities which are often referred to as ‘crèches’. As it is the policy of the DBE that Grade R should be part of the foundation phase, schools are increasingly offering it as part of their foundation phase programme, effectively creating a new sector for Grade R teaching. A number of pre-schools that existed prior to 1994 still exist and offer programmes exclusively for three to six year olds. These schools are funded by parents but with limited support from the state and thus exclude children from low-income homes.

In South Africa every facility that offers Grade R is expected to adopt and implement early childhood programmes that focus on the holistic development of young children. Within this programme the cognitive, social and emotional development of children is essential. However, the second wave of curriculum renewal (DoE, 2003) was the document that formalised learning within three learning programmes of which life skills is one. Conezio and French (2002: 12) are of the view that allowing children to engage with scientific phenomena is an important part of the curriculum at such a young age (two to five years), as it is the children’s “natural interests in science that can be the foundation for developing necessary schooling skills”. We shall, however, confine our study to the age group defined as belonging to Grade R as this grade is considered as being part of the foundation phase and is covered in the RNCS, which has recently been replaced by a third wave of curriculum renewal.

This research was conducted at three facilities that offer Grade R, two of which are in urban areas and one in a rural area. While visiting these facilities, one of the researchers observed that even though some resources were available, these resources were mainly meant as support for teaching numeracy and literacy, with little attention given to science. Since the researcher was a foundation phase student teacher specialising in science education, her interest lay in understanding how science is taught in the early years. As she was aware that the literature on science teaching and learning and teaching in the early years is limited, she was interested in conducting research into the way children understand scientific phenomena in three different contexts. Furthermore, she was also interested in exploring the factors that
influenced learners’ understanding of science in these contexts. The main research question that drove this research was:

How natural science education is understood by teachers and how is this part of the life skills curriculum implemented in the early years?

Subsidiary research questions were:

1. What do children understand about everyday natural science phenomena?
2. What do teachers understand about everyday natural science phenomena?
3. How is the natural science curriculum in the life skills programme implemented in this phase of schooling?
4. What are teachers’ views of natural science in this phase of schooling?

The three contexts of the study were a non-government crèche; a Grade R class at a primary school and a Grade R class at a pre-primary school.

Literature review

Research on early childhood development locally, as well as globally, has focused on policy initiatives in recent years (Mc Cafferty, 2008; Tarner, 2005; Chisholm, 2004; and Biersteker, 2010). However, the factors that impact on the development of children (Biersteker, 2010; Lynch, 2008; Hassink & Kiiver, 2007; Conezio & French, 2002) have always been at the centre of much research. One particular aspect of this research focuses on learning during the early years. Researchers in the field of early childhood education generally share certain theoretical assumptions with regard to how young children learn (Conezio & French, 2002). Examples of such assumptions are that young children learn best from personal experience, rather than from information imparted verbally (French, 1996) and that they construct knowledge through participation with others that foster experimentation, problem solving and social interaction (Gallas, 1995; Chaille & Britain, 1997). Furthermore, children should be allowed to exercise choice in their learning environment (Bredekamp & Copple, 1997). Science is an excellent vehicle for developing the above-mentioned skills, including all important social skills.

In the design of the foundation phase natural science curriculum, research with regard to learning in the early years was clearly a guiding force as the RNCS clearly stated that at this level, children are only expected to achieve investigative skills which in essence are ‘learning outcome 1’ (DoE, 2003). The CAPS document does not refer to investigative skills for Grade R. The learning outcome deals with scientific investigations and children are expected to experiment in their immediate environment. This should be done through series of tasks aimed at all the senses. Such experimental strategies could include looking, listening, smelling, tasting, falling, pulling, pushing, rolling, etc. all of which would help children to become more confident in their own abilities, including an extension of their vocabulary and in doing so, create an interest and a desire to learn (DoE, 2003).
While the RNCS describes the outcomes related to science learning, as well as what learners should be doing while learning science, there are no guidelines or learning programmes giving teachers clear directions as to the design of the types of activities that would promote science learning. The new NCS as it is discussed in the CAPS, in contrast to the RNCS, includes science concepts, as well as a list of topics to be covered. Like the RNCS it includes a list of basic process skills that learners should acquire. These skills can only be acquired if learners engage in investigative activities. However, guidance as to the types of investigations learners could engage in are also absent. Given that most teachers in the foundation phase, especially those who teach Grade R in non-governmental institutions, are not science specialists with little or no training in science teaching methodology, how science is taught in the early years is an issue of concern. The RNCS and the CAPS may be progressive documents in the way both envisage science teaching, but have policy makers considered how teachers would respond to this innovative curriculum? This is by no means unique to South Africa, but is a universal problem (Henze, Van Driel & Verloop, 2007).

While teachers of Grade R may not require significant ‘pedagogic content knowledge (PCK) to teach science concepts, they do require an understanding of the purpose of activities that promote science learning. Too often, because teachers are aware of the fact that science teaching is activity based, teachers design lessons that are activity-driven, rather than guided by the need to understand particular phenomena through an activity (Appleton, 2008). This may be true for any curriculum but the specialisation in science demands a particular type of PCK where teachers are required to progress from understanding ‘scientific matte’ for themselves, to becoming proficient at elucidating subject matter in ways that are comprehensible to learners (Geddis, 1993; Grossman, 1990 & Shulman, 1987).

An aspect that is repeatedly raised by researchers in the field of science education in the early years is the fact that most early childhood education teachers are poorly qualified to teach science (Garett, 2003). The result is teachers who are not confident to teach science as they are aware of their lack of content knowledge (Akerson & Flaningan, 2000; Smith & Neale, 1989). While the focus is on investigations in this phase, rather than content knowledge, adequate knowledge of science is necessary to design appropriate science experiences for young children. The ability to ask appropriate and meaningful questions is dependent on a sound understanding of scientific phenomena. Unfortunately this situation often leads to teacher dominated science lessons as this is the only way teachers are able to control events (Garett, 2003). This leaves very little opportunity for learners to interact with the activities and each other. Teachers who believe they do not have sufficient content knowledge to teach science are often wary of teaching science (Sherman & MacDonald, 2007). Such teachers have to overcome the obstacle of their perception of what it means to teach science at this level. They often have poor experiences with science and/or a general lack of engaging science experiences. This affects their beliefs about what it means to teach science, which are very influential on teachers’ abilities to be confident in the teaching of science. This has implications for the pre-service training as well as
the professional development of teachers: the provision of typical science experiences within the context of pedagogy will help teachers develop an understanding from the perspective of a learner of science and as a teacher of science. Unfortunately, very little attention is paid to the training of teachers with regard to life skills.

Further aspects that may have a profound influence on science teaching and learning in the foundation phase are both physical and social factors (Scholtz, Watson & Amosun, 2004). Physical factors include class size, books and equipment, while social factors include background of the learners, where they live and the expectations of the community. From the literature review, it is apparent that various factors influence the way a teacher will approach the implementation of the natural science curriculum.

Methodology

The study is framed by an interpretive paradigm. It is an interpretive study, because we, as researchers, interpreted the data at a particular time, and in a particular context. As interpretive researchers we seek to understand participant’s actions and practices in order to describe them in context. We analysed the interviews to see meaning embedded in these texts (De Vos, Strydom, Fouche & Delport, 2002).

The research approach is an integration of the qualitative and quantitative methods of data collection and analysis. The teacher interviews were analysed qualitatively, while the children's oral questionnaires on how their body works, parts of their body, about plants and animals and their use of science process skills were analysed quantitatively. The research design is that of a case study where the researcher aims to capture the reality of the participants’ lived experiences of and thoughts about a particular situation (Cohen, Manion & Morrison, 2000).

While each context forms a whole unit with boundaries, the fact that the same aspects of the phenomenon under scrutiny is explored in each context, justifies the view that all three localities are regarded as one case. This is referred to by Punch (2009) as a bounded system, emphasising the “unity and wholeness of that system”. Researching the three sites as a ‘unit’ allowed us to obtain a holistic and in-depth understanding of the situations. Various sources of data were used to obtain in-depth information about a particular context, a particular case of learning and teaching of natural science in Grade R (Punch, 2009).

We selected three Grade R classes in the greater Durban area, two urban and one rural. The rural class, which is referred to as the Green Class in this study, is part of a non-governmental day care centre (crèche), that is situated on the outskirts of the Durban metropolitan area. The first urban class, referred to as the Red Class in the study, is part of a primary school, while the second urban class, referred to as the Blue Class, is part of a pre-primary school. Our choice of schools was based on convenience as we visited the institutions for another project as well. The participants in our study were four teachers from each institution and five children from each class. The children were all in Grade R and were selected randomly from each class.
Data collection

Data were collected using two instruments, a questionnaire for children and a semi-structured interview for teachers.

Questionnaire

The children’s questionnaire was designed using the RNCS curriculum content as guideline. As children cannot read yet, each question was put to individual participants and their responses duly recorded. Children often responded in their mother tongue and their responses were translated by an isiZulu speaking translator. The translator was taken through the questionnaire beforehand and was very familiar with the questions in the instrument.

The RNCS explains what competences learners are expected to achieve by engaging in investigations. While the focus is on investigative skills, the expectation is that learners will acquire knowledge about their immediate environment through investigations. The questions in the questionnaire are based on activities that children would have engaged in previously, and, in the process, have acquired skills and basic knowledge. These activities are as follows:

1. **How their body works**
   Children do a number of activities exploring their bodies. They learn to name different parts and engage in activities in which they try to find out what the functions of different parts of their bodies are. This is also linked to Life Orientation. The questionnaire contains five questions based on knowledge children are expected to acquire through exploration.

2. **Your body**
   This section also contained five questions. The researcher pointed out certain parts of their bodies on a drawing of the outline of a human being and children were expected to point out where these parts of their bodies are located. The expectation was that children had previously engaged in activities investigating different parts of their bodies and were now able to apply this knowledge.

3. **The environment**
   This section contained three questions. One question was about plants and the purpose was to find out to what extent children had engaged with living plants and their life cycles. The second and third questions were about animals and were aimed at determining whether children were able to link structures in animals to structures in humans, demonstrating the skill of distinguishing between similarities and differences.

4. **Descriptions**
   The section contained two questions and assessed children’s ability to classify and describe. The questions in all four sections were designed to determine whether
children had developed simple process skills, such as observation, recording, application and classification through active engagement with natural phenomena, i.e. through the investigative process. The data obtained from the questionnaire enabled us to answer the first research question which was: What do children understand about everyday natural science phenomena?

**Interviews**

Teachers were interviewed individually and their responses recorded. The questions included in the interview schedule included questions related to teachers’ understanding of science in general; the understanding of science in the early years (foundation phase and earlier); the way in which they teach science and how important they think science is. The data obtained from the interviews enabled us to answer the remaining three research questions: What do teachers understand about everyday natural science phenomena? How is the natural science curriculum implemented in this phase of schooling? What are teachers’ views of natural science in this phase of schooling?

The interviews and questionnaire are fit for the purpose as they were designed with the research questions in mind. All data collected served the purpose of answering the research questions. A limitation of the study may be the fact that little triangulation occurred as the two different instruments produced different data and answered different questions. The fact that children and teachers were interviewed individually ensured that they were not influenced by each other.

**Results**

The findings are reported in two parts: Firstly, children’s responses to the questionnaire and secondly teachers’ responses to the interview questions. Although the questionnaire was divided into four main questions, the results are reported in three parts as the results for the first two sections are reported together. The reason for this is that the questions cover the same topic. Part one deals with the question relating to what children think are in their bodies; part two deals with the environment and part three deals with classification and description. The results from all three sections serve to answer the first research question. Table 1 presents the results for the first part of the questionnaire.

<table>
<thead>
<tr>
<th>Table 1: Children’s interpretation of what is in their bodies.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average percentage for each group</strong></td>
</tr>
<tr>
<td><strong>Green Class</strong></td>
</tr>
<tr>
<td>59,2</td>
</tr>
</tbody>
</table>

The results show that children from Green Class have some understanding of the functioning of their bodies and the ability to link parts of their bodies, observed in pictures, to their own bodies, while children from Red and Blue Classes have a very good understanding of both phenomena. The second part presents results on
Children's understanding of phenomena in the environment and the events occurring around them. Table 2 presents the results.

**Table 2: Children's understanding of environmental phenomena.**

<table>
<thead>
<tr>
<th>Average percentage for each group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Class</td>
</tr>
<tr>
<td>83,6</td>
</tr>
</tbody>
</table>

Children in all three locations have a very good understanding of the basic life processes of plants, as well as the ability to describe similarities and differences. However, the children from Green Class did not perform as well as children from the other two facilities. The third part presents the results of children's ability to classify and describe phenomena. Table 3 presents the results.

**Table 3: Children's ability to classify and describe.**

<table>
<thead>
<tr>
<th>Average percentage for each group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Class</td>
</tr>
<tr>
<td>63,3</td>
</tr>
</tbody>
</table>

The total performance for each group is presented in Table 4.

**Table 4: Average performance for all questions.**

<table>
<thead>
<tr>
<th>Total average percentage for each group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Class</td>
</tr>
<tr>
<td>66,0</td>
</tr>
</tbody>
</table>

The results obtained for the children's questionnaire answers the first research question in that it reveals the understanding of children with regard to natural phenomena. The question arises as to why the children from Green Class did not perform as well as children from the other two classes. This rural crèche is more isolated than the two urban schools and that it depends on funding for its operation, the teachers are sent for basic early childhood training and invariably are less qualified in the sense that their understanding of science is poorer than those from urban areas. The urban schools are also better resourced than the rural crèche, pointing to the importance of adequate resources for schools. As the research has shown, teachers who are poorly qualified to teach science often neglect to teach it in a way that assists in the development of process skills. This may be the case with the teachers of the Green Class in this study.

The second phase of the research focused on teachers' understanding of certain science concepts, the importance they place on science, as well as the way they teach science. In observing the teachers teaching science the use of investigative methods was the main focus. This was important as it is one of the outcomes of the curriculum
where learners are expected to develop and use process skills. The teachers from the crèche opted to use electricity to support their statements. Apparently electricity is a topic often discussed. Table 5 presents the results for the teachers teaching at the rural crèche.

**Table 5: Teachers responses (crèche).**

<table>
<thead>
<tr>
<th>Questions</th>
<th>Teacher A</th>
<th>Teacher B</th>
<th>Teacher C</th>
<th>Teacher D</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your understanding of science? (electricity)</td>
<td>Working with electricity</td>
<td>Electricity</td>
<td>Talk about electricity, wear shoes, call electrician, children must stay away. Electricity must stay off the ground (e.g. ovens).</td>
<td>Hard to learn, calculations, dangerous.</td>
</tr>
<tr>
<td>What is your understanding of science in the ECD phase?</td>
<td>Yes, cleaning</td>
<td>Yes, explaining about electricity and dangers.</td>
<td>Talk about electricity, wear shoes, call electrician, children must stay away. Electricity must stay off the ground (e.g. ovens).</td>
<td>-</td>
</tr>
<tr>
<td>Is science education important to young children? Why/why not?</td>
<td>Yes</td>
<td>Yes, they know it is dangerous.</td>
<td>Yes, people must be taught about dangers.</td>
<td>Yes</td>
</tr>
<tr>
<td>Do you integrate science education into the curriculum? If so indicate: Time spent.</td>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>How often a week?</td>
<td>Once a day</td>
<td>Once a week</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
The results show that teachers are still very much inclined to control the learning environment by telling children what they ought to know. There is no indication that any of the four teachers planned investigative activities with regard to learning about electricity. There is also evidence of teachers’ misconceptions in the way they describe electricity (Teacher C). There is no evidence that teachers implement a process approach by planning investigative activities for children in this phase. Their focus is on telling children what they need to know. Their views of the importance of science education support the view that they see science as a body of knowledge that needs to be transmitted. Teachers could not say how much time they spent on science lessons, although two teachers were able to indicate that they taught science once a week. Examples of activities mentioned by all teachers are not investigative by nature. Table 6 presents the views of teachers form the Grade R classes in the primary school.

**Table 6: Teachers responses (primary school).**

<table>
<thead>
<tr>
<th>Questions</th>
<th>Teacher A</th>
<th>Teacher B</th>
<th>Teacher C</th>
<th>Teacher D</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your understanding of science?</td>
<td>Experiments, working out answers; measurements, hard methodical (formulas) things to follow.</td>
<td>Experiments, different aspects of the environment.</td>
<td>The world and how it works, finer details.</td>
<td>Laboratories, green smoke, stuff, medication, research.</td>
</tr>
<tr>
<td>What is your understanding of science in the ECD Phase?</td>
<td>More mathematical than science, integrated through other subjects (e.g. movement) incidental learning, working with concrete objects, all to increase vocabulary.</td>
<td>Experiments of different topics, hands on, incidental learning.</td>
<td>Finding out why things happen, incidental.</td>
<td>Experimental, practical</td>
</tr>
</tbody>
</table>
### Grade R teachers at a primary school

<table>
<thead>
<tr>
<th>Questions</th>
<th>Teacher A</th>
<th>Teacher B</th>
<th>Teacher C</th>
<th>Teacher D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is science education important to young children? Why/why not?</td>
<td>Yes, for them to see, touch.</td>
<td>Yes, very, need to know why things happen and how to look after it.</td>
<td>Yes</td>
<td>Yes, for the full development of the child.</td>
</tr>
<tr>
<td>Do you integrate science education into the curriculum? If so indicate:</td>
<td>15-20 minutes</td>
<td>15-20 minutes</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Time spent.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How often a week?</td>
<td>Once</td>
<td>Once a week – discussion</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Example of activities done</td>
<td>Show and tell</td>
<td>Discussion of the moon, incidental learning.</td>
<td>Discussion, show and tell, looking at books, garden work, lots of posters.</td>
<td>Discussion</td>
</tr>
</tbody>
</table>

Teachers’ responses with regard to their understanding of science reveal some understanding of the nature of science. They are more aware than the teachers from the rural crèche that science is more a process than a product, although some misconceptions are still evident. They have a better sense of the integrative nature of life skills, as well as the fact that the essence of the approach to science in the early years should be an exploration of natural phenomena. These teachers were better able to articulate their views of the importance of science to children, in this phase, by explaining the value of science education. Two of the teachers were also quite specific about the time spent on science. Examples of activities conducted give some indication of understanding the investigative nature of science, although there is still a strong emphasis on discussion rather than action. Table 7 presents the views of teachers form the Grade R classes in the pre-primary school.
### Table 7: Teachers responses (pre-primary school).

<table>
<thead>
<tr>
<th>Questions</th>
<th>Teacher A</th>
<th>Teacher B</th>
<th>Teacher C</th>
<th>Teacher D</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your understanding of science?</td>
<td>Finding an answer to a question.</td>
<td>Natural, physical</td>
<td>How things work, how things come together, process.</td>
<td>Way things work – weather, environment, chemicals, experiments - how things react.</td>
</tr>
<tr>
<td>What is your understanding of science in the ECD phase?</td>
<td>Exploring with experiments, measuring, different capacities, obtaining a certain result, do experiment, see if what you thought was correct, natural science around the world (e.g. plant growing).</td>
<td>Nature – things that are not man-made. (God made them) Own bodies - how to look after it, understanding of and how it works.</td>
<td>Environmental (own environment) Close to home and themselves.</td>
<td>How things work, what you need to survive, movement.</td>
</tr>
<tr>
<td>Is science education important to young children? Why/why not?</td>
<td>Yes, from a young age they need to know what is happening around them. It created foundations.</td>
<td>Yes, science you see every day learning allows you to think about it, more understanding of your surroundings.</td>
<td>Yes, very, should know why things are there, how they got there, how they work. To be creative and inventive.</td>
<td>Yes, the basics so they can apply basic knowledge later on in life.</td>
</tr>
<tr>
<td>Do you integrate science education into the curriculum? If so indicate: Time spent.</td>
<td>30 minutes</td>
<td>10 min (discussion) 30 minutes (Activities)</td>
<td>30 minutes</td>
<td>15-30 minutes)</td>
</tr>
</tbody>
</table>
### Grade R teachers at a pre-primary school

<table>
<thead>
<tr>
<th>Questions</th>
<th>Teacher A</th>
<th>Teacher B</th>
<th>Teacher C</th>
<th>Teacher D</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often a week?</td>
<td>Once</td>
<td>Everyday</td>
<td>One allotted time, but basically everyday.</td>
<td>Everyday</td>
</tr>
<tr>
<td>Example of activities done</td>
<td>Growing plants, experiments on movement</td>
<td>Discussion about weather, body, doing a nature collage using seeds, leaves, stories.</td>
<td>Exploration tables (put something different on each table) games as a follow-up activity, using real objects.</td>
<td>Growing plants</td>
</tr>
</tbody>
</table>

Teachers at this school, like their colleagues from the primary school, have some idea of the nature of science. There is evidence of understanding that science is a process of investigation and discovery. In answering the question with regard to science in the early years, it was evident that teachers had experience of investigative activities as well as the skill of integrating science with other learning areas. Their views of the importance of science in the early years also confirm some understanding of the nature of science. Three of the four teachers at this school also spend considerable time integrating science in their teaching of language and numeracy. Their examples of activities in science show that two of the teachers employ some aspects of an investigative approach.

### Discussion and conclusion

The results show that the urban schools scored higher than the rural crèche. There may be a number of reasons for this, but the most obvious reason is most likely a lack of resources, including human resources. While data were not collected on teachers’ qualifications, observing the teachers in action indicated that the teachers at the crèche were not as skilled in teaching science as the teachers from the urban schools (Geddies, 1993; Grossman, 1990). Another factor that could have impacted on learners results is the fact that children from the rural crèche are not as conversant in English as those from the urban schools. However, the fact that a translator was at hand to translate children’s responses should not have had a significant effect. Children from the crèche scored poorly in the section on the functions of different parts of the body. This may be due to the fact that children in the Grade R class were on average younger than those from urban schools, and they may not have been developmentally ready for this kind of activity. Integrating this section with Life Orientation and specifically healthy living should enhance learning of this topic, but if teachers do not have the skill
to integrate, and plan for active learning, learners may not be able to progress from naming structures to understanding their purpose (Lynch, 2008).

All three groups scored reasonably high in the section on the environment. This may be due to the fact that the questions were more related to their everyday experiences than other questions as most children were familiar with most of the animals in the pictures. Furthermore, the fact that pictures were used to prompt responses meant that language was not as central to the answers as the other questions.

The scores for section three were also fairly high (all scored above 80%), although the Green Class had the lowest score of the three. As this section required children to describe objects, language was an important factor and those children who were not as proficient in their mother tongue, struggled to explain what was observed. In conclusion, it can be said that this research showed that children from three different Grade R contexts had a reasonable understanding of natural science phenomena, with children from the rural crèche having a poorer understanding than children from urban crèches. Whether this understanding is due to their engagement in investigative activities or simply from discussion in class, is difficult to determine, although there is some indication that children have acquired basic process skills, which point to some level of investigative activities.

With regard to teachers’ understanding of science and specifically their understanding of science education in the early years, there appears to be significant differences between teachers from the rural crèche and those from the urban schools. Teachers from the primary and pre-primary schools have a better understanding of how to implement the curriculum, while the teachers from the rural crèche have a poor understanding of the curriculum. Casual observation of the teachers from the two schools indicated a mismatch between what they say and what they do. They appear to have learnt the discourse of investigative science, without really implementing it as often as the curriculum requires. There is more emphasis on discussion than on activity based learning. While all teachers indicated that they thought it was important to learn science, teachers for the rural crèche could not articulate why they said so.

The question does arise as to why children from the pre-primary school had the highest overall score of the three schools. The reason for this may be that this is a preschool that focuses only on ECD and the ethos is very much one of learning through doing (Gallas, 1995; Chaille & Britain, 1997). While the facilities and the teacher’s qualifications are on a par with the pre-primary school, the Red Class is part of a primary school and there is more emphasis on preparing children for formal schooling than on allowing them to learn by exploring, and this may account for the lower score. The Green Class is at a disadvantage with regard to funding and with regards to the qualifications of its teachers.

The finding of this study raises the issue of the necessity for the National Department of Education to take responsibility for early childhood education nationally. While crèches like the one which participated in this study are doing the best they can under financial and other constraints, we still have the situation of
under-qualified teachers teaching in the foundation phase. Teachers in such facilities are also given very little support in developing the skills to implement the curriculum. While it is the policy of the DoE to include Grade R in the foundation phase in the primary school, teachers who teach Grade R in these schools may do well to interact more closely with teachers who teach at pre-primary schools that focus exclusively on early childhood education. Such interaction may assist them in planning more activities with an investigative approach. In conclusion while there is strong evidence to suggest that teacher qualifications are crucial in teaching science through investigation, it also depends on how schools and particularly teachers, view science teaching.

Endnote
1. With the implementation of the new NCS, the Curriculum and Assessment Policy Statement (CAPS) replaces Subject Statements, Learning Programme Guidelines and Subject Assessment Guidelines in an effort to improve implementation. However, the CAPS still places emphasis on the process of enquiry which involves the development of science process skills. This research is therefore still relevant in spite of policy document changes.

References


Linguistic liminality in the early years of school: Urban South African children ‘betwixt and between’ languages of learning

Abstract
This article is about an investigation into the English spoken language competence of 144 first graders in two urban (‘township’) schools in the Gauteng Province of South Africa. The study was conducted from an anthropological and a cognitive developmental perspective. In one school isiZulu and Sesotho are used mainly as medium of instruction, while in the other school the language of teaching and learning is English. The inquiry is part of longitudinal panel research in which children’s overall development and school progress over four years is documented by way of growth modelling. This initial assessment of the children’s basic interpersonal communication skills in English found, not unexpectedly, that the children in the first mentioned school know English mostly to the extent of the naming of objects, while the children in the other school are able to use morpho-syntactically more complex language. These findings may shed some light on the phenomenon of school culture liminality in its interplay with linguistic liminality, considering that children’s basic English may scaffold their academic English.

Keywords: cognitive academic language; linguistic liminality; medium of instruction; school culture; rite of passage; early-exit model.
Introduction: Moving from home to school and into the ‘mother tongue’ debate

In this article we investigate one aspect of the issue of language of learning and teaching (LoLT) in the early grades in South African schools, namely linguistic liminality, a term which refers to a transition phase, such as the initial phase of getting to know the discursive practices of school learning. Recent publications on issues of language of instruction, in this country, highlight the on-going conundrum of what could be reasonably considered as the optimal language for learning in early school education (Makalela, 2009; 2005; Mashiya, 2011; Heugh, 2006; 2008; Koch et al., 2009; Burkett & Landon, 2004; Alexander, 2009). In this article we enter that debate with regard to how it concerns children who move from home to school within their ‘mother community’ only marginally. In such communities children learn to speak a language at home and in a community where that language is dominant, as is illustrated, for example, in the research of Koch et al. (2009) in a rural Eastern Cape school and Mashiya (2011) in rural KwaZulu-Natal schools. In such communities the school is, still, culturally and linguistically, a communal public space, where the identity of young children can easily be said to be formed by ‘the village’ that ‘brings up the child’. It makes good sense that, in such places, children learn best in schools that do not opt for what is known as the ‘early-exit’ (Heugh, 2006) model of home language, or mother tongue instruction. According to this model, the most prevalent one in South Africa, schools switch to English by Grade 4. We assume that this switch is gradual in most instances. Researchers, such as Heugh (2006; 2008), argue, drawing from seminal studies conducted elsewhere in the world, that the ‘late-exit’ model, according to which children are gradually instructed in the end-language (English), but only fully so by Grade 6 to 9, promises the establishment of ‘additive bilingualism’ in the children’s linguistic repertoire. This, in turn, is argued to become a sturdy cognitive tool for school learning in the transfer of cognitive academic language from one language to the other (Koch et al., 2009). Dampier (2012) argues, however, that the notion of ‘additive bilingualism’ is not a guarantee for linguistic equity.

Because of the rising currency of English as social capital, and despite the cries for more prominence for African languages in the public domain, it is not surprising that even rural schools introduce English as the language of learning and teaching (LoLT) much earlier than Grade 4. Mashiya (2011) found that teachers ‘smuggled’ English into their pedagogy in the foundation phase, because they regarded it as a passport to a better life for the children. She studied the use of language in rural KwaZulu-Natal schools and found that teachers saw themselves as facilitators of a better future for foundation phase learners by teaching them partly in English, despite what the policy, along with much research, recommends for the first, formative years of school. In this single investigation of 20 teachers the inherent tension regarding the language for learning is obvious, despite the homogeneity of culture and language in rural KwaZulu-Natal. Strange as the logic may seem from the perspective of policy makers and academics, there is a strong groundswell of this cultural practice in schools, a practice
that is by nature ‘bottom-up’. Intuitively, teachers seem to want to ease the children’s rite of passage into academic learning by giving English more prominence.

Our concern, however, is not with schools in linguistically (near) homogenous communities, such as rural KwaZulu-Natal, or the rural Eastern Cape, where the two mentioned studies were conducted, but with the children in schools in urban areas where there is a larger degree of linguistic diversity, such as in the industrial heartland of the country in the greater Johannesburg metropolitan area. Here growing children are exposed, and subject to, the various languages that are used in their suburbs and towns, some of which are, moreover, not indigenous to South Africa, with young children becoming venerable ‘polyglots’ (Makalela, 2009). The children who enter school in these areas are mostly exposed to, at least, three languages in their pre-school years. Godsell (2011) argues that the notion of ‘mother tongue’ is not easily defined in such areas. The children attending the English medium ‘private’ school (School A), that we studied, use up to eight different languages in their home environment. In the other, public school (School B), only Sesotho and isiZulu speaking children are admitted.

School A provides for two pre-school years, as well as a Grade R year, in which to learn English before Grade 1, when the children are fully immersed in English as the medium of instruction. In School B there is a Grade R class, where English is already taught directly as the first additional language, by way of translation, in a bid to decrease intrasentential, random code-switching (Henning, forthcoming). In these two very different schools the problems are mostly the same, but they are approached in different ways. School A opts for immersion into English, with almost no attention being paid to the children’s various home languages. There are just too many different ‘mother tongues’ for these to feature in the curriculum. In fact, these (mostly African) children learn Afrikaans as the first additional language. In School B the children learn their home language as the primary language, and in the foundation phase it is used for much of the pedagogy, with the exception of the teaching of numeracy, which is now taught partly in English, while isiZulu and Sesotho are used in explanation and feedback, and also in back translations. The Grade 1 teachers translate and discuss concepts and processes in numeracy teaching into isiZulu and Sesotho, while trying to avoid intrasentential code-switching. They, and the children, translate forward and backward (Henning, forthcoming), in the process trying to cement concepts in different lexis and syntax in both English and the mother tongue. The option to use English for numeracy teaching was the choice of the teachers when they realised, mid-way through the first cohort of Grade R in this new school, that few children and teachers use the vernacular when talking about concepts, object names, and actions in numeracy and mathematics generally. The vernacular terminology seemed stranger than those in English for the young learners. The example given by these teachers and others with whom we have worked is the word for ‘nine’ in isiZulu, which is isishiyagalolunye. This is also what Mashiya (2011) found in her study of the use of English in rural schools. The teachers and the principal in School B admitted
that they had to think carefully to, for example, use counting words that they had long forgotten in their first languages of Sesotho or isiZulu.

In this article, we examine the data from a study of the use of oral interactional English by 144 first graders; 71 in School A and 73 in School B, using a custom-designed instrument that assessed their listening and speaking competence, and thus also their phonological alertness and awareness. The instrument is also used in a longitudinal panel inquiry in School B over four years, capturing the children’s growth in receptive and expressive oral English competence along with other measures that capture their cognitive development, their numeracy and mathematical competence, and their development in isiZulu or Sesotho, as well as their literacy in two languages. For this article we report on the results of the first assessment of spoken English in this programme, and compare the children’s competence in English with that of urban children who live in a similar community, but who go to the all-English private school (School A). What we wanted to find out in this part of the inquiry was only how the two groups of children compared on the same English spoken language competence test in Grade 1, when they are on the verge of their academic school career, after having settled into classroom routine and the school ‘rituals’.

On the threshold of school culture and the language of learning: A double liminality

In our study of the children’s English language competence we argue on three theories (cf. Figure 1). Firstly, we borrow the concept of ‘liminality’ from the field of anthropology. Originally this term was used to explain the transition phases between two periods in the rite of passage of children and youth, as studied by anthropologists, such as Van Gennep (1960) and Turner (1969). The application of the term has since spread widely and is now used to refer to any time period when a person is ‘on the threshold’ of a new phase of social development, such as the learning of a new language, or a new cultural practice (Iannacci, 2008). Liminality in Grade 1 can be seen as a cultural ‘turning point’ (Vygotsky, 1978) in the children’s rite of passage towards becoming ‘a learner in a school’, or a ‘pupil in a classroom’, a position which changes their status in society. On this theory we view young children entering formal education as being liminal for a period of time, and would assume that this lasts no longer than a few months. They are on a threshold and they are, to use Turner’s (1969) phrase, ‘betwixt and between’ informal home- and street-life, or pre-school and day-care centres, and formal schooling contexts. Upon entering formal education, they also have to learn a new language (i.e. English as the first additional language) along with what is a new culture. One can argue that there is now a double liminality; not only do they have to adapt to the new lifestyle with its specific cultural practices, but they also have to start learning the language that will, eventually, be the main medium of teaching and learning, in addition to getting acquainted with the specific form of their mother tongue, as used in the context of a school. For some the switch to
There is a real conundrum here for researchers, practitioners, and policy makers. Koch et al. (2009: 95) argue:

There is a large body of research (in Africa – for example, Bamgbose, 2000; McDonald, 1990; and amongst other linguistic minorities [sic] internationally (Ramirez et al., 1991; Thomas & Collier, 2002) which shows that replacement of the mother tongue by a second or additional language by the start of schooling, or early transition to a second language as LoLT are not consonant with academic success, except where the mother tongue has high prestige or vitality in the so-called immersion programmes.

These authors continue in a comprehensive review of the literature by saying that children’s mother tongue should ideally be established very firmly in a school context, taking around six years in a late-exit model of bilingual education, to ground them sufficiently and to prepare them to switch to their first additional language, English, which has been studied at school for a number of years as well, as the medium of instruction. Ideally speaking, we do not disagree. Pragmatically speaking, we have to disagree, although we consider both advantages and disadvantages in the three main options of 1) late-exit, 2) early-exit and 3) full immersion, the latter with the mother tongue as an object of study for as long as possible, and ensuring that it maintains ‘high prestige’ and ‘vitality’ as Koch et al. (ibid) suggest.

There are valid arguments, theoretically, for different standpoints: If the children are immersed into English too soon they stand to lose the known benefits of the ‘late-exit’ model. For literacy education, especially (Snow, 2010; Snow, Griffin & Burns, 2005), they need refined phonological awareness of the language that will be the platform for their initial literacy, alphabetical skills (grasped and mastered) vocabulary (knowledge of the world), and syntax of the target language that they must learn to read. On the other hand, if they start learning through the medium of English later rather than sooner, they will not have sufficient English to carry them conceptually through the first murky waters of new concept learning. Reading comprehension and learning, generally, will be influenced negatively. Whichever way a school language policy may direct the learners they will have gains and losses. The research in South African does not as yet have longitudinal data to echo what bilingual education research in the USA, such Thomson and Collier (2002), has found after decades of large-scale research. We are not convinced, either, that these findings can be applied to all South African contexts, as most of the research in that vast literature concerns Spanish and English, or French and English, in the case of Canadian research – languages from the Indo-European group that share many similarities in syntax and morphology as well as lexis with English, with many cognates. This is not the case with indigenous South African languages.

In our study of the two groups, we viewed the data as indications of how the children are specifically using informal English as part of their ‘rite of passage’ into the language they will need for the bulk of their formal education, whether their schools follow the ‘early-‘, or ‘late-exit’, or the ‘immersion’ policy. We, thus, examine a second
form of liminality, the ‘between languages’ phenomenon of linguistic strangeness. However, the complexity of this second liminality is compounded, in all three models, by the fact that not only do the children need to learn another language in which to communicate, they also need to learn a specific form, or a set of discursive practices of this language that functions specifically in pedagogic contexts. They have to learn a ‘school and subject language’ with its expository and abstract textual characteristics. They have to learn the ways of decontextualised language. While being ‘betwixt and between’ their home language and English, they need to be enculturated into this specific form of language, known in the literature as “cognitive, academic language” (Cummins, 1979), which is probably the Achilles heel of bilingual and dual language education (Lems, Miller & Soro, 2009) in the early grades. This is the language that will have to (eventually) communicate/capture abstract concepts (Setati et al., 2002).

The profile of a ‘liminal’ Grade 1 child in an urban South African school becomes more complex when one thinks of such a child’s future trajectory through the next 11 years of school. The double liminality of the early grades is exacerbated by the fact that cognitive academic language itself may have to be learned in the bilingual mode, first, in the primary language of a classroom, and then later in English for seamless learning across the curriculum. Cummins (1979), who first theorised the distinction between the language of basic interpersonal communication skills (BICS) and cognitive academic language proficiency (CALP), recently emphasised the complexity of CALP as he continues to develop the theory. Lems, Miller and Soro (2009: 41) explain:

(Cummins) revised his ideas related to BICS and CALP (Cummins, 2003; 2008). And this included a third domain of discrete language skills that include phonology, literacy, and grammatical knowledge. These skills can be learned in conjunction with BICS and CALP, but they require teachers to use explicit instruction in which teachers demonstrate, or explain to students exactly how certain language features work.

These authors also say that CALP does not transfer directly from one language to another, something that seems to be assumed by many, as if it is a general, non-linguistic tool that only manifests via language. Clearly authors are guided by their position on language and cognition (cf. the edited volume of Bowerman & Levinson, 2001). It takes a long time to develop CALP in any language and this is acknowledged by researchers who advocate the ‘late-exit’ option as strongly as Heugh (2006) does. Moreover, learners get accustomed to the register of academic language in the everyday details, the ‘nitty-gritty’ of language processing in a specific language, through which they then learn to use higher order skills that are communicated in specific registers. The details are learned through ‘explicit instruction’ (ibid). And the registers together form a discursive genre and are learned in pedagogical interactions so as to be used, as Vygotsky (1978) would describe it, as ‘higher psychological tools’. These skills are not learned like BICS tools, for example, on the playground or in the community. Teachers teach them explicitly and they teach them within a target language in a specific subject. From this perspective the children in School A can be argued to have a better chance of acquiring the amount of (English) CALP they will need in the higher grades in primary school and later in high school sooner, because
teachers infuse this type of language use into their pedagogy all the time. On this view one can also argue that the children in School A, thus, have some advantage, because they build cognitive academic language structures, in a ‘nitty-gritty’ way over time in the formative years of primary school. On the other hand, children who encounter it for the first time in English in Grade 4 or later then enter another liminal period; hovering there until they are proficient in the cognitive academic language of the various learning areas, in English. And we believe that each period of hovering ‘betwixt and between’ (Turner, 1969) delays learning, because it takes long to establish a firm grounding in CALP. Intuitively, the teachers at School B knew this, because they decided to teach mathematics and numeracy in English in Grade 1, to “make the learners feel more sure of what we say” (Teacher in School B). Cummins’ (1979) theory also says that it takes many years to achieve CALP in a second language. In the current policy and practice context this would mean that most learners in South Africa will spend much of their primary school years learning the language of learning. Anthropologically speaking such learners will be in linguistic and, arguably, also in some conceptual limbo during this time.

Our view is that not enough linguistic, anthropological examination of young children as participants in school culture is conducted, and that a ‘rite of passage’ view of their beginning school years may add to our understanding of the psychological, and the social issues involved in learning during the foundation phase.

**Learning to use language as ‘sign’ in conceptual development**

Developing an (educational) anthropological view of young children’s entry into school, would be incomplete without invoking a view on learning language and on learning to use it as a tool for the development of what Lev Vygotsky has termed, ‘higher psychological processes’, which are achieved by way of semiotic mediation (Vygotsky, 1978: 45). He distinguishes these processes from ‘lower’ or ‘elementary’ processes, which are innate and which develop naturally. We go directly to his discussion of one of his research findings in the 1930s:

> We have found that sign operations appear as a result of a complex and prolonged process subject to all the basic laws of psychological evolution. This means that the sign-using activity in children is neither simply invented, nor passed down by adults; rather it arises from something that is originally not a sign operation and becomes one only after a series of qualitative transformations (ibid: 47).

Learning to use a language is closely connected with ‘qualitative transformations’ in cognitive development and specifically, we would add, with conceptual development. From this viewpoint, learning to use language means not only learning to communicate socially, but also learning to be involved in active and on-going interactions with those who use the sign (language), so that, during the interactions, a ‘series of qualitative transformations’ can occur because of the role that the sign plays in making these changes. With the aid of language and ‘inner speech’ (thinking) they are not only formed with language, but are also expressed in language. Although many concepts
and naïve theories are formed by young children before they are able to express their knowing in language (in oral speech and in gestures), the rate at which these are formed increases incrementally with the use of language (Gopnik & Nazzi, 2003; Gopnik, 2001; Bowerman & Levinson, 2001). Briefly stated, thoughts and language meet bi-directionally; higher psychological processes and linguistic signs meet each other both in 1) the internalisation between the ‘two planes’ (the inter- and intra-psychological planes of which Vygotsky speaks often in his work), and 2) in the expression of thoughts in language, thus using the ‘sign’ both socioculturally and psychologically (Vygotsky, 1978; 1986; Kozulin, 1990). Thoughts and language are intertwined in both thinking and speaking/writing. On this view, one would argue that language is a scaffold for thought and that thought is, reciprocally, a scaffold for language, and that this holds true incrementally as children learn more language and become increasingly literate as well. The development of CALP follows this process.

On the surface, this notion would seem to militate against the use of contemporary cognitive developmental psychologists’ views to explore the relationship between language and learning, because many of these scholars are perceived as ‘innatists’, a rude term if ever there was one in the sociocultural (neo-Vygotskian) education community. Nonetheless, we fruitfully use the ideas of Susan Carey (1985 2009) and Alison Gopnik (2001, 2003), for instance. For us there is not a scholarly ‘divide’ between ‘innatists’ and ‘culturalists’ or ‘interactionists’. We do not ascribe to such a divide that deprives a fuller view of learning and language, because from the psycholinguistic, cognitive developmental literature (such as Bowerman & Levinson’s edited volume, 2001; Evans & Levinson, 2009) it is evident that cognitive development and linguistic development need to be studied in tandem and that Vygotsky, whose work spawned many interactionist theories, recognised this. We also think that there is an ‘interactionist’ leaning in the work of cognitive developmentalists, such as Carey and Gopnik, which is often not examined by radical socioculturalists, such as Rogoff (1990). Moreover, we think it is important to produce an astute account of the interlinking notions discernable in theories on learning and language, which is why we invoke the work of developmental cognitive psychologists along with classical Vygotskian theory (1978; 1986).

We specifically give attention to the notion of the ‘theory’ theory of cognitive development (Gopnik & Meltzoff, 1997; Gopnik, 2001), which proposes that very young children learn to engage in their world by hypothesising and testing their observations in their actions, including their use of signs, as their biological development increases and as they then can observe more and more of their world as they become more mobile. They construct naïve theories about their world, and during interactions with other humans learn to name components of these theories, not only with reference to objects, but also actions and even emotions, and other ‘things of the mind’ (Gopnik & Meltzoff, 1997). They ‘bootstrap’ the different stages of their theory building (Carey, 1985; 2009) with one concept leading to another until a theory works well enough to be tested and practiced. From around 15 – 18 months this process accelerates because with more signs available, more concepts can be organised with the help of language
as toddlers take on the world and the signs around them. Utilising their basic and innate brain architecture, children start developing their minds and start to control their lives and to direct the further unfolding of their very brain- and mind architecture. And all of this happens in continuous interaction with the (cultural/signing) world around them. It is an on-going dialectical process, captured in the work of Vygotsky, who added a historical, material tone to his view of this learning process (Vygotsky, 1978: 73):

Our concept of development implies a rejection of the frequently held view that cognitive development results from the gradual accumulation of separate changes. We believe that child development is a complex, dialectical process, characterised by periodicity, unevenness in the development of different functions, metamorphosis, or qualitative transformation of one form into another, intertwining of external and internal factors, and adaptive processes which overcome impediments that the child encounters.

Elsewhere Vygotsky uses the term ‘interlacement’ (John-Steiner & Souberman, 1978) to emphasise that higher mental processes ‘interlace’ with what has been given to humans biologically. He posits that, in the tradition of Freidrich Engels, from whom he learned much regarding human work and tool-use in development, it is the tool, and especially also the signing tool (such as language), that plays a significant role in the development of these higher psychological functions (Cole & Scribner, 1978: 1-15). What we find in this part of Vygotsky’s work is that semiotically mediated action (learning through the use of signs and other tools) contributes substantially to the development of higher mental functions.

Thus, we argue that in the already challenging liminal phase of children’s school entry there is an added liminality; it is the liminality of language for CALP purposes. Children have to learn to use language in a very specific way as a higher functioning tool and as scaffold for their conceptual development; they learn a new discourse with its own discursive practices, of which the very new discourse of numeracy/mathematics is one example. They test new theories of their world. The ‘threshold’ of the liminal period may extend too far into their primary school journey when they have to learn new sign-use when, rather, they could be learning concepts in quick succession with already existing signs. What we are saying is that by the time children reach Grade 4 signs should be scaffolding this learning incrementally as they represent the abstract world in science, in mathematics and in learning about the world. Advocates of the ‘late-exit’ model may not have it right for current urban South African conditions. If the signs and signing systems of primary school children are not secured in one CALP as early as possible, they may remain in limbo, ‘betwixt and between’ two under-developed (bilingual) CALPs, harvesting the worst of two educational worlds.
From this discussion of a double liminality our argument emerges: We make the claim that urban children in multilingual contexts in South Africa may, ultimately, be advantaged if they can learn English in their pre-school years as they do in School A. They already learn much more of the additional language than is advocated by Koch et al. (2009) for rural schools in the late-exit model. There is a caveat, though, in this argument: by the same token it is essential that they study their own home language as a first additional language so that it can 'interlace' with English CALP and retain its vitality. We believe that this 'interlacing', which should not be confused with code-switching, or with direct CALP transfer, is one of the assets of bilingual education and dual language education models. Bilingual people generally have a wider access to knowledge if both languages are well developed. Another caveat is that although our reasoning is definitely pragmatic, we do not doubt that language is part of identity and we do not wish for the diminishment of the tapestry of South African languages, or of the right to 'mother tongue instruction' against the wishes of such fervent advocates for it as Skutnabb-Kangas (2009) for instance. We forward this view because it is educationally fair and socially just to educate children optimally and to prepare them for learning as comprehensively as possible right at the outset of their school career. The jury is still out on the benefits of late-exit models of mother tongue instruction in the research community in South Africa. But the judgment on South African children, not only in the often mentioned international surveys, but increasingly in research here at home as well, is that our young children and youth are not learning enough to sustain them or their country. In ex-model C schools they seem to do better (Godsell,
2011), perhaps because of many variables, one of which is that in those schools they develop English CALP early.

The inquiry: Capturing language comprehension and expression in Grade 1

The test items on the instrument were designed to get a glimpse of the children's basic interpersonal communication skills, ranging from vocabulary (naming words) and a little more complex morpho-syntactical skills. The test included discussion of photos and oral communication with the interviewer, who spoke only in English. The design logic of the tool was that children would be able to participate individually in a test period of about 20 minutes, in which we would get a sense of their use of English at an interpersonal, informal level (BICS, in Cummins’s theory). We aimed at finding some indication of phonological sensitivity, semantics, and grammar and syntax, by assessing their listening and speaking competence. We also wished to judge some organising ability of the English that they know already, especially in the items that required some elaboration and coherence of expression. Because the test will be repeated for four years, their growth can eventually be measured and compared to the results in the standardised mathematics and the cognitive ability tests and other tests that are also administered over four years. The test would, for now, also capture their pragmatic knowledge of English in the following categories in items that relate to different parts of their lives:

- Family and home
- Images and objects in context
- Decontextualised images and objects
- Popular culture and icons
- Oral instructions
- Greeting

Because the test is used in conjunction with other tests in the mentioned panel inquiry of four years in School B, the levels of complexity of the responses were coded on a scale from 0-6, so that individual children’s development may be gauged over time in all of these various tests of numeracy and mathematics knowledge, general cognitive ability development, and competence in isiZulu or Sesotho in typical panel design logic.

The rating scale is aimed at measuring the level of spoken language (BICS) competence in accordance with the following seven categories:

- 0 = No reaction, answer given that did not relate to the question or the student spoke in his/her mother tongue.
- 1 = Names one object or action. No clauses. One word answers.
- 2 = Names two objects or actions. No clauses. One word answers.
- 3 = Names two or more objects or actions and constructs a simple clause structure (subject, verb).
In May and June 2011 one researcher administered the tests in both schools. In School A 71 children from a total of 240 were selected, while all 73 children in Grade 1 at School B participated. The test administrator conducted the interview with each child individually, recording their responses to the various items during the sessions and immediately afterwards.

The scores were entered into the PASW Statistics 18 programme and were analysed for reliability and normality, while means for the different schools were compared and analysed for significant differences.

The results

As expected, the children from School A, where English is introduced at least two years before the children enter Grade R, performed significantly better than students from School B, where instruction is conducted in the mother tongue of the respective classes, i.e. isiZulu and Sesotho. The mean scores for pupils from School A is 3.22 (Figure 2) on the rating continuum, while the results for School B is 1.78 (Figure 3). The children in School A were able to name two or more objects and actions using the subject, verb structure frequently and with ease.
By comparison, more students from School A were, in general, able to answer in complete sentences, while fewer students from School B were able to do so. In fact, the ability of children in this school, to answer in complete sentences appears to be isolated and incongruous, since the majority are, at best, only able to name a number of objects. Few go so far as to supply answers that employ the subject, verb structure, as is revealed in the following illustration:

**Figure 2**: Average scores for students from School A.
The majority of children in School B provided answers that fall within the categories 0, 1 and 2 on the rating continuum, which suggests that for the most part students were able to name objects using one word, nominals only and no verbals.

**Figure 3: Average scores for students from School B.**

Discussion: Early immersion into English: Advantage or disadvantage?

In our analysis we were again confronted with the literature, both in South Africa and elsewhere, especially in the USA, that claims advantage for home language (Snow, 2010; Alexander, 2009; Heugh, 2008, 2006; Koch et al., 2009) in early schooling. There are many publications on this topic and it is becoming a burning issue in manuscripts submitted to South African journals, such as the South African Journal of Childhood Education and the South African Journal of Education. The argument remains the same: in the long run it is better for children to be educated in their home language and to learn to read and write and become numerate in this language, even if they have to transfer to another language eventually. Leading figures in South African public discussion of language in schools consistently argue for various positions on the
'mother tongue side' of the debate, focusing on identity, better learning as well as upward mobility in one utterance. Our position is that this position is impossible and that bilingual education research in English and Spanish, which is what most debaters refer to, cannot be transferred wholly to South African conditions and history.

New research is beginning to question this view. Firstly, in accordance with Cummins’s theory and much subsequent research, there is agreement that the time for CALP to develop is substantial, varying between five and eight years (Koch et al., 2009) and, secondly, CALP does not transfer from the first language to the second language (Lems et al., 2009), because the logic of CALP is syntactical and also lodged in some morphology. In fact, CALP in the second language relies on knowledge of the second language itself; and CALP requires ‘nitty-gritty’ features that are learned over time in any one language (Lems et al., 2009). If one accepts the view that CALP is a major ‘higher psychological tool’, then one has to conclude that CALP (in English) needs to be developed as soon as possible for children who are going to learn through the medium of English if such education is available. The challenging question is, of course, how that may be done. There is much irrationality in language policy in education (Heugh, 2006, 2008; Makalela, 2005; 2009) and in South Africa substantial, large scale, longitudinal research is needed to make feasible and fair suggestions. To get empirical answers to the burning issues of language and instruction will, however, require much time and research funding. Even small-scale research, such as the exemplary work of Koch et al. (2009), is costly and it requires time. In fact the school where they based their intervention is slowly coming apart at the seams and their theorising about bilingual education and the role of isiXhosa in learning may have to be taken elsewhere for empirical extension. South African children cannot be left in a maze of liminality and random code-switching until, perhaps, somewhere in the future, we will know if the research conducted elsewhere can really be applied to our context.

The results of this inquiry will be further interpreted when the (home language) BICS of children in School B has been analysed – to see what their competence in their first language is and how that compares to the competence in English of the children in School A. Preliminary results show that the children mix two or more African languages with English and that they speak a child version of isicamtho, often not knowing how to respond to the formal language. For now, however, these results signal a warning. The chances that teachers will be able to infuse CALP in English sufficiently before Grade 4 are weak. A middle road will have to be sought through translation and unambiguous ‘switching’ of language code in classrooms.

The results of studies, such as those conducted by Mashiya, (2011), and the damning evidence of international surveys of competence in literacy and mathematics, in which South African pupils participated, signal the same warning. Although most analysts look for the problem elsewhere, such as in lack of school resources, teacher quality, school culture, school management, home resources, poverty, illness, the role of the unions, and many more, the issue of the possible negative effects of ‘mother tongue instruction’ is not raised with any conviction, although the issue of language is almost
always alluded to. No one wants to say outright that the language policies may be one of the sources of the lack of advancement of the majority of young children. For some it may be regarded as linguistic suicide, or ‘genocide’, as Skutnabb-Kangas (2009) puts it, on par with the dying out of natural species.\(^5\)

We argue that it may well be that mother-tongue instruction can be one of the roots of our educational problems, not because the African languages of this country cannot capture concepts, but because their use in classrooms seems to be inconsistent at a time when young children, on the threshold of formal education, desperately need linguistic consistency. Researchers who are firm advocates of multilingual education (cf. the edited volume by Skutnabb-Kangas & Heugh, 2010) need to investigate the schools in metropolitan Johannesburg to witness how children and teachers struggle in the language maze; especially, since multilingual textbooks that present the cognitive language children need to develop advanced literacy, are not the norm beyond Grade 4 (Mahlalela-Thusi & Heugh, 2010). In fact, publishers compete to sell the most English textbooks, an example of which is the 10 current English textbooks for history education.\(^6\)

Early school is a time when young learners need to be able to trust the signs that they encounter for the long term – signs that help them to build concepts of a ‘higher psychological’ order (Vygotsky, 1978), and with which they can build sturdy CALP frameworks. We are concerned about the possible dangers of an extended linguistic liminality. The 73 children in School B are already somewhat bilingual. Their ‘conversational’ English is, however, limited to single words or broken clauses. No one can predict if, or when, they will be on par with the children in School A, and whether they will surpass them in performance eventually in the use of (English) CALP in their learning beyond the primary school. What we can say, based on the findings, is that the children in School B carry a heavier load in their rite of passage.

**Conclusion: Are urban children getting their fair share of education?**

In both the schools that we investigated, but especially in School A, there is a joyful use of different languages, creoles and dialects when the children are not engaged in formal class work. In fact, on the grounds of School A there is a venerable ‘Tower of Babel’ noise during break times. Children from Zimbabwe, Nigeria, the DRC and Ghana can be heard playing and singing along with children from different parts of South Africa. When they get to the classroom door, they enter that space of school culture where they change their code of conduct and their linguistic code and the foreground their functional language identity. When the tests were conducted with them, they were comfortable and entered the ‘English’ space of their lives, using its signs as artefacts and tools quite confidently. The children in School B, when they took the tests, entered an unfamiliar domain, where the security net of their language was not available. Although they understood some of the questions, the response did not come naturally to them, because they had not learned this linguistic code and this code of conduct.
If we juxtapose the two schools, it can be said, when looking at the surface information at this moment in time, that the children of School A have an advantage in terms of developing a sturdy CALP, which will scaffold their learning from now on, and which will not change to another code. The children in School B will have learned CALP in a bilingual, dual-language way, because during all of the school day they use their home language, but when they learn numeracy and mathematics, they switch to English. We wonder how secure they feel, and whether their liminality will persist. We also wonder what the implications are for the building of concepts, given the new world they will have to enter in Grade 4, and given the bootstrapping role of language signs and conceptual development (Gopnik, 2001 Bowerman & Levinson, 2001).

In order to take a cognitive developmental and psycholinguistic developmental look at children's learning in the first year of school, it is not unwarranted to invoke an anthropological perspective as we have done in this article. The advantage of such a perspective, with regard to language and pedagogy, is that it takes one out of the discourse of policy and the politics of language and identity. It simply sees the school as an important cultural place, where new entrants arrive in a liminal state, and where, perhaps, this entry into ‘schoolhood’ should be made somewhat easier for the novice learners, so that they can leave the sense of ‘betwixt and between’ behind them as soon as possible, and get on with what their real cultural practice in school is. They need to learn to think and do their utmost to unfold their potential in a society that needs each of them to build a future. If they are kept in linguistic limbo for too long, they miss a period of their rite of passage that they can never repeat. In social cultures one has to grow up and become an adult to be integrated in society. Cultures, dynamic as they are, can be ruthless in this regard: you always have to move on to the next phase in your passage (traveling), or move out, or into a sub-culture, such as unemployed youth do. ‘Schoolhood’ is an important stage in cultures everywhere. Young people who do not go through this stage successfully are relegated to the margins of society as ‘liminars’ (Turner, 1982), without employment, without future, and without voice.

As conclusion to their article Koch et al. (2009: 107) express the following wish with regard to the ‘late-exit’ model of additive bilingualism in education:

As the additive model is rolled out in more schools there is a strong hope that the inequities resulting from South Africa’s colonial and political history will be eroded, as learners are given the opportunity to learn to high levels through their mother tongue and at the same time achieve high levels in English.

From the perspective of our inquiry this hope is not likely to be realised in most of the urban, public schools that we know in areas such as Soweto.

Endnotes
1. Turner (1969) uses this term to describe the stage between two cultural phases in a rite of passage.
2. Schools such as School A are subsidised by the provincial education department and have something in common with the ‘charter schools’ in the USA as well as the ‘private education

3. The annual national assessment in numeracy in Grade 2 is administered in English, for example, while the literacy tests is conducted in the mother tongue.

4. The disturbing Annual National Assessment results have just been made available. In it the downward trend in foundation phase learning is evident.

5. This same author also has argued that functional language identity is to be distinguished from personal language identity.

6. Morgan (2010) found that only one of them embraces the spirit of the curriculum.

References


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Challenges facing the early childhood development sector in South Africa

Abstract
In this review article, the context of young children in South Africa in 2012 is described and the main challenges affecting children and the early childhood development sector (ECD) in South Africa are investigated. A situation analysis of ECD in South Africa was undertaken using South African government ECD policy and programme implementation reports. There has been progress since 1994, both quantitatively and qualitatively. The number of children in Grade R has trebled since 2001, government education and social development budgets have increased substantially and 58% of children at ECD centres nationally are now subsidised. More children are in provision and in better quality provision than before. However, much still remains to be done before we can say with confidence that the needs of our youngest children are being met. This study identifies infrastructure, nutrition, ECD programmes, teacher training, institutional capacity and funding as the major gaps in ECD provision.

Keywords: early childhood development (ECD); education; South Africa; Grade R; non-profit organisations; policy.
Introduction

The majority of young children in South Africa are negatively impacted by a range of social and economic inequalities. Apartheid and the resultant socio-economic inequalities have created a childhood of adversity for most black South African children in the country, including inadequate access to health care, education, social services and quality nutrition. This has undermined the development of our children. The South African constitution, through the Bill of Rights, makes provision for children’s socio-economic rights, including the right to basic education and protection from neglect, abuse and exploitation. However, South Africa still has a long way to go to effectively meet the needs of the majority of children.

This paper provides a broad overview of the current state of the early childhood development sector in South Africa. This includes describing the context of children, what has been done in ECD since 1994, and the significant challenges affecting the ECD sector in six key areas, namely infrastructure, nutrition, ECD programming, teacher training, institutional capacity and funding.

Early childhood development

The National Department of Education defines early childhood development (ECD) as “... the processes by which children from birth to nine years of age grow and thrive physically, mentally, emotionally, morally and socially” (DoE, 2001a). Early childhood development is recognised as the foundation for success in future learning. Quality early learning programmes prepare children for adulthood, providing them with the necessary opportunities for social, cognitive, spiritual, physical and emotional development. These programmes assist in laying the foundation for holistic development, whilst cultivating a love for lifelong learning (Biersteker & Dawes, 2008).

The National Department of Education is responsible for the five to nine year old age cohort, and the Department of Social Development is focused on the birth to four year old age cohort. The Department of Health covers the birth to nine year old age cohort.

Children in South Africa

There are approximately 6,5 million South African children under the age of seven. Of these, some 3,8 million children (59,2%) live in circumstances of dire poverty (DoSD, DoE & Doh, 2004).

These children, along with their families, teachers, communities, and the South African government face a range of challenges and obstacles. The most significant of these are poverty, education, health and HIV/AIDS.
Poverty

More than half of South Africa’s children live in severe poverty, which jeopardises the realisation of their rights as contained in the South African Constitution (Du Plessis & Conley, 2007). Children living in poverty are extremely vulnerable, discriminated against and isolated. Monetary poverty is closely connected to poor health and well-being, as well as to limited access to education, nutrition, healthcare services and safe environments. The General Household Survey of 2009 showed that 61% of children in South Africa lived below the poverty line (with a per capita income below R522 per month). Closely linked to this income poverty indicator is unemployment. Statistics SA (2010) indicated that 36% of children reside in households where no adults are employed.

The government does provide financial support for children when their parents are too poor to do so, in order for them to meet their basic needs. This is achieved through social assistance programmes, such as the Child Support Grant, paid to the caregivers of eligible children. While this grant has increased over the years since its introduction, from R100 per month in 1998 to R280 in April 2012, this is still far too little. By April 2011, 10.5 million children under the age of 16 years were accessing the Child Support Grant, which makes it the largest child poverty alleviation programme in South Africa. Research has shown that this grant has contributed towards food, education as well as basic goods and services for millions of children across the country (South African Child Gauge, 2010).

Education

Education is a basic human right and is fundamental to building life-long learning and economic opportunities. South Africa has a high rate of school enrollment with 97% of 11.4 million school-going age children in Grades 1 – 12 at an educational facility. Encouragingly, by 2011, 67% of five-year-olds were enrolled in Grade R, which suggests progress towards the government’s revised goal of universal access to Grade R by 2014 (South African Child Gauge, 2010: 99).

The relevant government departments (namely the Department of Social Development, Education, and Health), has identified the need to increase access to ECD programmes, as well as enhance the quality of ECD programmes and services, specifically for children from disadvantaged backgrounds. Funding to both early childhood development centres (birth to four years of age), through the Department of Social Development, and to Grade R (five to six years of age) through the Department of Education (DoBE, DoSD & UNICEF, 2010) has been increased. According to the Tracking Public Expenditure and Assessing Service Quality in Early Childhood Development in South Africa report –

... spending within provincial Departments of Education on Grade R increased from R377 million in 2003/04 to a budgeted R983 million in 2007/08 and a projected R1 253 million in 2009/10 (DoBE, DoSD & UNICEF, 2010).
With regard to children between the ages of 0 to 4 years attending ECD facilities, in 2006/07 the Department of Social Development spent R350 million by providing 5,531 registered ECD sites with subsidies for a total of 314,912 children (DoBE, DoSD & UNICEF, 2010).

Although much has been done to improve access and quality of early learning programmes in both ECD facilities and Grade R classrooms, there is a long way to go in the enhancement of service delivery (DoBE, DoSD & UNICEF, 2010). Some of the prominent challenges and obstacles facing ECD facilities include absence of learning materials and resources, especially within the classroom setting, minimal funding, lack of qualified teachers, inadequate security for children whilst at the ECD facility, as well as poor toilet amenities (DoBE, DoSD & UNICEF, 2010).

**Health**

The United Nations Convention on the Rights of the Child (1989) states that every child has “the right to the enjoyment of the highest attainable standard of health”. A commonly used gauge for measuring health status and socio-economic development are infant and child mortality rates. In South Africa, one of the Millennium Development Goals (adopted in 2000) for reducing poverty and inequality in the world, aims to reduce the under-five mortality rate by two-thirds from the 1990 figure of 60 deaths per 1,000 live births to that of 20 by 2015. ASSA 2008 has estimated that the infant mortality rate has steadily declined from 52 deaths per 1,000 live births in 2000 to 34 in 2010 (as cited in the South African Child Gauge, 2011).

Despite the fact that the Government has established programmes aimed at reducing hunger, malnutrition and food insecurity, child hunger remains a challenge with approximately 16% of children living in households where child hunger has been reported. This figure indicates a substantial decrease in reported child hunger from 30% in 2002 and 18% in 2007 (South African Child Gauge, 2011). Hunger is highest among black African children with 17% of the total black African child population living in households that reported child hunger compared to 13% of coloured children, 2% Indian and only 1% of white children.

The South African Constitution states that everyone has the right to sufficient water, as well as to an environment that is not harmful to their health or well-being. Water is a requirement for health, hygiene and sanitation. Whilst young children have the right to sufficient water, the water that they have access to is often of poor quality resulting in our young children becoming particularly vulnerable to cholera and diarrhoea. In 2009, seven million children lived in households that did not have direct access to clean drinking water, and there had been very little improvement in children’s access to water between 2002 and 2009 (South African Child Gauge, 2010: 102). In addition to this, there is a lack of children’s access to basic sanitation in many South African households. A significant number of children do not have access to adequate sanitation facilities, thereby making use of unventilated pit latrines, buckets and/or
open land. Inadequate sanitation results in young children becoming susceptible to a range of illnesses and diseases that compromise their health and nutritional status.

**HIV/Aids**

South Africa is the country with the highest number of people living with HIV. Paediatric HIV is propelled by the adult epidemic with most children being infected prior to, and during the birth process, and later through breastfeeding. The Actuarial Society of South Africa (ASSA) 2008 AIDS and Demographic Model has indicated that while the prevalence of paediatric HIV is on the increase, the rate at which it is spreading is decreasing (as cited in the South African Child Gauge, 2011). This is attributed to the increased survival rates of children who now have access to antiretroviral treatment (ART). In 2010, an estimated 438,000 children under the age of 15 years were HIV positive, with the Western Cape having the lowest HIV-prevalence rate at 1.2% in 2010, compared to KwaZulu-Natal which had the highest rate of 4.1%.

Many children reside in child-headed households in which all members are under the age of 18 years. Family and community networks support the growing numbers of orphaned children in our country, mainly as a result of the HIV/Aids pandemic. The General Household Survey of 2009 indicated that South Africa is home to 95,000 children living in child-headed households. These children are more at risk than others of poor access to services, inconsistent income and poor living circumstances (South African Child Gauge, 2011).

**What has been done in ECD since 1994?**

As a country South Africa has come a long way since the watershed year, 1994. There have been a number of initiatives affecting the lives of young children directly. Some have been very positive and others less successful. These successes include:

2. Free medical and health care services for pregnant women and for children aged birth to six years of age.
3. The establishment of a Directorate for Early Childhood Development within the national Education Department.
4. The establishment of a Children’s section within the national Social Development Department.
5. An Education White Paper (number 5) on early childhood development and a Welfare White paper with a section on early childhood development.
6. The introduction of Grade R for children aged five years turning six years.
7. The Expanded Public Works Programme has a focus on early childhood development.
8. A nationwide ECD Audit surveying 23,482 ECD sites was successfully completed in 2000.

9. The nine provincial Social Development Departments making ECD subsidies available for ECD sites each year.

10. The nine provincial Education Departments making Grade R grants-in-aid available.

11. The Children’s Act, with two chapters that deal with partial care facilities and early childhood development programmes, has been passed by Parliament.

12. Many grant-making organisations and companies have continued their support of the early childhood development sector.

13. 10.5 million children received the Child Support Grant (CSG) by April 2011.

ECD policy priority

The main ECD policy priority of the South African government after 2001 has been the establishment of a national system of provision, called Grade R, for children aged five to six (DoE, 2001a). Over the past 11 years this goal has been partially achieved, although there is still much to be done in order for this policy goal. This section explores the relevant aspects of current Grade R provisioning, including funding and teacher training and qualifications.

Using DBE statistics, enrollment as at the first quarter of 2011 (the latest figures) was 734,654. Table 1 shows the provincial distribution of these children. According to department officials, this figure excludes children in independent and community-based sites, but no figures are given for these, and these numbers could not be verified.

Based on the Department of Education statistics, 493,129 additional children entered Grade R in the first 10 years after the release of the education White Paper number 5. The rate of take up of Grade R places has been 37,201 in 2002; 36,661 in 2003; 41,100 in 2004; 48,710 in 2005; 36,444 in 2006; 45,884 in 2007; 56,274 in 2008; 76,424 in 2009; 86,980 in 2010 and 27,451 in 2011.

It is clear that the compulsory/universal provision target was not reached by 2010, as envisaged in the education White Paper 5, and was extended by the President to 2014. At the present take up rate it will take the country at least until 2018 to reach Government’s target of a place in Grade R for every child before Grade 1.

Table 1 excludes any comment on quality. There is, however, certainly considerable unevenness in quality across the nine provinces.
Table 1: Grade R enrollment 2000 – 2011.

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Cape</td>
<td>157,184</td>
<td>164,803</td>
<td>154,514</td>
<td>133,249</td>
<td>112,889</td>
<td>96,384</td>
<td>105,231</td>
<td>75,571</td>
<td>46,371</td>
<td>23,562</td>
<td>18,873</td>
<td>19,555</td>
</tr>
<tr>
<td>Free State</td>
<td>28,627</td>
<td>27,209</td>
<td>23,767</td>
<td>23,699</td>
<td>22,429</td>
<td>20,072</td>
<td>18,449</td>
<td>16,482</td>
<td>16,323</td>
<td>17,220</td>
<td>16,002</td>
<td>15,025</td>
</tr>
<tr>
<td>Gauteng</td>
<td>86,240</td>
<td>76,460</td>
<td>64,935</td>
<td>54,979</td>
<td>49,931</td>
<td>47,314</td>
<td>41,073</td>
<td>34,690</td>
<td>31,666</td>
<td>28,189</td>
<td>23,920</td>
<td>21,368</td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>181,585</td>
<td>175,541</td>
<td>154,666</td>
<td>129,742</td>
<td>118,884</td>
<td>92,948</td>
<td>79,276</td>
<td>73,098</td>
<td>75,996</td>
<td>72,312</td>
<td>73,993</td>
<td>66,031</td>
</tr>
<tr>
<td>Limpopo</td>
<td>117,279</td>
<td>113,432</td>
<td>97,570</td>
<td>98,963</td>
<td>93,030</td>
<td>102,969</td>
<td>98,273</td>
<td>89,725</td>
<td>89,790</td>
<td>90,332</td>
<td>84,243</td>
<td>75,219</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>56,726</td>
<td>51,758</td>
<td>46,194</td>
<td>40,671</td>
<td>34,962</td>
<td>25,734</td>
<td>14,171</td>
<td>23,695</td>
<td>13,884</td>
<td>12,148</td>
<td>5,803</td>
<td>10,922</td>
</tr>
<tr>
<td>North West</td>
<td>42,937</td>
<td>42,010</td>
<td>30,117</td>
<td>22,294</td>
<td>16,143</td>
<td>15,311</td>
<td>9,737</td>
<td>5,625</td>
<td>4,325</td>
<td>3,142</td>
<td>3,176</td>
<td>3,193</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>13,153</td>
<td>12,387</td>
<td>11,508</td>
<td>9,575</td>
<td>8,423</td>
<td>7,259</td>
<td>6,598</td>
<td>5,875</td>
<td>5,500</td>
<td>3,744</td>
<td>4,042</td>
<td>3,972</td>
</tr>
<tr>
<td>Western Cape</td>
<td>50,923</td>
<td>43,603</td>
<td>36,895</td>
<td>30,627</td>
<td>30,834</td>
<td>33,650</td>
<td>32,389</td>
<td>31,726</td>
<td>31,532</td>
<td>28,077</td>
<td>11,473</td>
<td>11,346</td>
</tr>
</tbody>
</table>

Based on the Department of Basic Education (DoBE) school realities figures, it is relatively easy to calculate the national provision rate for Grade R. Just over 1.1 million children enter Grade 1 each year; therefore, the provision rate for Grade R currently stands at approximately 67%.

**Funding of Grade R**

Education White Paper 5 indicates that financial responsibility for Grade R is the responsibility of provincial education departments and in the short term, provision is made for subsidies to be paid to schools to allow them to establish Grade R facilities. Eventually, Grade R will be funded via Norms and Standards for Grade R funding. The intention is to subsidise Grade R by 75%, because “the financial burden for ECD falls disproportionately on the poor.” (DoE, 2001a: 12).

White Paper 5 also states that the Grade R programme is able to function at –

... a cost considerably lower than primary school-based provision since the latter uses provincially-employed educators, whereas the practitioners at community-based sites are not employed by government and are paid considerably less (DoE, 2001a: 30).

Actual funding for Grade R from 2004/5 to 2008/9 is presented in Table 2.

**Table 2:** Grade R expenditure by province, 2004/05 to 2008/09 (R’000).

<table>
<thead>
<tr>
<th>Province</th>
<th>2004/5</th>
<th>2005/6</th>
<th>2006/7</th>
<th>2007/8</th>
<th>2008/9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Cape</td>
<td>36,937</td>
<td>39,817</td>
<td>69,941</td>
<td>120,218</td>
<td>145,486</td>
</tr>
<tr>
<td>Free State</td>
<td>29,509</td>
<td>33,585</td>
<td>49,638</td>
<td>52,146</td>
<td>54,614</td>
</tr>
<tr>
<td>Gauteng</td>
<td>51,807</td>
<td>49,000</td>
<td>79,000</td>
<td>109,000</td>
<td>149,000</td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>79,697</td>
<td>68,239</td>
<td>102,658</td>
<td>117,688</td>
<td>125,928</td>
</tr>
<tr>
<td>Limpopo</td>
<td>23,535</td>
<td>18,883</td>
<td>52,723</td>
<td>79,976</td>
<td>159,033</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>33,072</td>
<td>47,790</td>
<td>51,801</td>
<td>126,729</td>
<td>220,658</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>13,198</td>
<td>15,819</td>
<td>18,141</td>
<td>30,336</td>
<td>42,798</td>
</tr>
<tr>
<td>North West</td>
<td>118,231</td>
<td>126,084</td>
<td>152,510</td>
<td>162,127</td>
<td>172,561</td>
</tr>
<tr>
<td>Western Cape</td>
<td>60,135</td>
<td>71,923</td>
<td>107,397</td>
<td>181,930</td>
<td>244,923</td>
</tr>
<tr>
<td>Total</td>
<td>446,121</td>
<td>471,140</td>
<td>683,809</td>
<td>980,150</td>
<td>1,315,001</td>
</tr>
</tbody>
</table>


Provincial Grade R spending was at R1,315 billion in 2008/09. Provincial Grade R spending, as a percentage of total education spending, for all provinces was 0.74% in 2003/4, that is, less than one percent. Expenditure on Grade R by 2008/09 increased to 1.3% of the total education expenditure.
Challenges facing the ECD sector

Notwithstanding the progress made in early childhood development and in Grade R provision since 1994, children in South Africa still face significant challenges. We focus here on infrastructure, nutrition, programme options, ECD teachers, institutional capacity and funding.

Infrastructure

Infrastructure in ECD is a particular problem in the South African context. Many ECD facilities function without basic infrastructure, such as running water, access to electricity or suitable sanitation. The nation-wide ECD audit of 2000 showed that about 8% of ECD centres in South Africa have none of these basic infrastructure requirements.

Infrastructure in ECD can be looked at across three distinct facility types; in public schools, in registered community-based ECD facilities, and in unregistered community-based ECD facilities. In public schools ECD provisioning is limited to Grade R provisioning, whereas registered and unregistered community-based facilities generally provide ECD services to children from birth through to, and including, Grade R.

As such, at public schools the infrastructure for ECD (which is solely Grade R) is part of the school infrastructure which is built and maintained by each province's Department of Education (DoE) or the Department of Public Works. In registered community-based facilities, although the Grade-R learning programme is registered with the DoBE, the facilities are registered with the Department of Social Development (DoSD), and thus have to meet the requirements of this department. The DoSD does not provide any significant funding for infrastructure upgrades or maintenance (over and above the regular ECD child subsidy), and although it does require an inspection from the local government Environmental Health Office before approving the registration of any ECD community-based facility, any upgrade or maintenance needs to be funded by the Governing Body or owner of the facility. The result is that the infrastructure in registered community-based facilities is of a poorer standard than that of the Grade R facilities in public schools.

In a study conducted in 2011 by the national Department of Basic Education (DoBE), the Department of Social Development, and UNICEF, researchers found that the infrastructure in the community-based facilities was of a poorer standard than that of the public schools. They also found that the unregistered facilities had a significant amount of buildings that were rated as being “in a bad or very bad condition” (DoBE, DoSD & UNICEF, 2010: 61). The main reason many of these facilities are unregistered is directly related to the fact that they cannot meet the infrastructure requirements necessary for registration.

More specifically, this study found that: almost all public schools in South Africa had electricity (91%), whereas almost one third of registered and unregistered community-based ECD facilities did not have any electricity (21% and 27% respectively). Approximately, half of all facilities, regardless of type, had piped water inside the
building; between 50% and 60% of all ECD facilities had regular flushing toilets, however, roughly 10% of unregistered community-based ECD facilities made use of buckets or potties, or did not have any toilet facilities whatsoever. A significant portion of ECD facilities had more than 40 children per playroom (the norms which have been set for class ratios are 30 children per class for Grade R and 20 children per class for pre-Grade R). Safety concerns were most prevalent at unregistered ECD facilities: 16% of these ECD facilities did not have any form of secure fencing around their premises, and roughly 28% prepared food in the same area in which children spend the majority of their time. In terms of overall infrastructure quality, significant differences were found across the provinces, with the province that the ECD facility was based in being a stronger predictor of infrastructure quality than facility type.

It is important to note that poor infrastructure at ECD facilities not only presents significant health and safety risks to children attending these facilities, but can also point to poor quality ECD service provisioning. The researchers found that, although “programmatically sound ECD” can be provided in poor quality buildings, “an unsafe and impoverished learning environment often is associated with substandard ECD with limited development opportunities” (DoBE, DoSD & UNICEF, 2010: 94).

The National Department of Basic Education provides physical space for Grade R classes at public primary schools. The National Department of Social Development, the Department of Public Works and various municipalities have provided buildings for ECD centres, but this is on an ad-hoc basis and is not part of any government programme. It is mostly non-profit organisations (NPOs) and donors who provide funds for infrastructure development and upgrading ECD centres.

**Nutrition**

Due to the extraordinarily high prevalence of poverty in South Africa, hunger, malnutrition and food insecurity are significant challenges facing children in communities across the country. Nutrition is a basic physical need. The absence of adequate nutrition greatly affects a child’s early development (composed of physical development, brain development, cognitive and learning abilities), which can lead to significant, negative adult outcomes, such as reduced earning potential in adulthood (Wildeman & Mbebetho, 2005; Victora et al., 2008). The physical effects of inadequate nutrition are severe. Even in mild cases, malnourishment can cause direct and irreversible structural damage to the brain, impair motor development, cause significant developmental retardation, affect cognitive development, impair exploratory behaviour, impair learning abilities and educational achievement, and can have long-lasting impacts on their health (Duggan, Watkins & Walker, 2008; Victora et al., 2008).

In terms of learning, malnutrition and hunger greatly affect a child’s ability to concentrate, focus attention, and perform complex tasks (Wildeman & Mbebetho, 2005). Children who lack certain nutrients (such as iron and iodine) or those who
suffer from general malnutrition, or simply hunger, therefore, do not have the same readiness for learning as their healthy, adequately nourished counterparts.

These negative consequences affect children’s ability to achieve their full potential, stunting not only the individual child’s ability to flourish in adulthood, but collectively limiting the country’s potential development (McNeill & Donald, 2006). Longitudinal research has shown that malnourishment in childhood is directly related to later negative adult outcomes. This can be seen in educational achievement (poor performance in school, and less schooling reached), reduced economic productivity resulting in lower human capital (income and assets), and a higher risk of adult diseases (including chronic diseases such as cancer) (Victora et al., 2008). Consequently, researchers report that the best predictor of human capital in adulthood was height-for-age at two years, height being directly determined by adequate nutrition (Victora et al., 2008).

The long-lasting effects of inadequate nutrition place significant additional stress on the health care expenditure of a country. Improving nutrition, through various interventions, can bring about not only health and educational benefits to children, but economic benefits to the country as a whole. Interventions in nutrition in South Africa are offered by a number of service providers, including NPOs and private companies. These interventions include school feeding schemes, the provision of deficient micronutrients through fortified sachet powders/pap to homes and community based ECD facilities, the facilitation and start-up of food gardens, as well as skills development and training on nutrition and agricultural development. Government, specifically the Department of Social Development, in the form of an ECD subsidy, and the Department of Education, in the form of the National School Nutrition Programme (NSNP), also contribute to, and run, nutrition programmes.

In the National Audit of ECD Service Quality in South Africa, the Department of Basic Education, Department of Social Development & UNICEF (2011), found that all ECD facilities surveyed provided some form of nutrition. Not surprisingly, the quality and quantity of the meals varied from public schools (in the form of Grade R classes), to registered community-based ECD facilities and unregistered ECD facilities; with the majority of registered and unregistered community-based ECD facilities offering two or more meals a day, whereas the majority of public schools only offered one meal a day.

In terms of funding for nutrition, the audit found that most public schools (71%) provided food to the children in their care through the NSNP programme, whereas only 29% of registered community-based ECD facilities were part of the NSNP programme. At these community ECD facilities, the meals were provided mainly by the facility itself (41%), or the meals were provided by the parents and sent from home (28%). More than three quarters (79%) of the unregistered ECD facilities provide meals themselves, and only 37% indicated that meals were provided by the parents and sent from home. It is important to note that children attending ECD programmes in public schools are most likely to receive their nutrition through the NSNP programme, whereas food for children from registered and subsidised community-based ECD facilities is supposed
to be funded through the DoSD per child ECD subsidy. However, this subsidy is often also used for administration and personnel costs (HSRC, 2009), and, for this reason, optimal nutritional meal provision is not guaranteed in these ECD centres.

**ECD Programming**

The ECD sector offers a number of ECD programme options to meet the needs of children and their caregivers. These programmes include the traditional centre-based ECD model of provision, and ‘non-traditional’ models, such as playgroups and family outreach programmes. This section sets out these various programme options and provides insight into the best approach to offering various programmes.

Traditional ECD provision involves the common practice of ECD teachers providing ECD care and education for a class of children, ranging from birth to six years of age and is provided in various physical structures. This can take place at public schools (in the form of Grade R classes), and at community-based facilities (in the form of pre-Grade R and Grade R classes). Community-based facilities can be further broken down according to physical space; the ECD service can be provided at home-based facilities where an ECD practitioner converts a portion of their house to accommodate children, or it can be provided at centre-based facilities where an ECD teacher or a community has a dedicated building for the children.

Historically, centre-based ECD has been the main form of ECD provision, however, one of the biggest challenges in ECD South Africa today, remains the need to increase access to these programmes. Due to poverty and distance, many families do not have the resources to pay for ECD services and parents, and caregivers cannot afford to send their children to traditional ECD facilities. How to provide access to ECD centres for these children has now become the major challenge. Complementary ECD programme options have been developed to provide services to marginalised young children. Increasingly, it is being accepted that ECD can be provided in various forms and places.

Non-traditional ECD provision involves a range of programme options, usually provided by members of the community, who have been trained by service providers such as ECD NPOs and/or government departments. This form of ECD provision includes two predominant programmes, namely family outreach and play groups.

Family outreach programmes involve the provision of ECD services within a home. Family outreach workers (also referred to as Family or Community Motivators) work with a number of families in a community and visit each family for a set amount of time each week or month, depending on the nature of the specific programme. During a home visit, the family outreach worker works directly with the caregiver by sharing knowledge on how to provide early learning stimulation and on various other important topics such health, safety and nutrition. The family outreach worker also works directly with the children in their homes; demonstrating to the caregiver the various activities that can be done at home, and providing the children with a foundation for their early learning. These programmes aim to empower parents and
primary caregivers to provide early learning opportunities to their own children. The intention of the family outreach programme is that parents continue to provide these early learning activities and opportunities to their children after the completion of the programme.

Similarly, informal play groups involve the provision of ECD services within a community setting or informal gathering. In these programmes, a fieldworker works with a group of parents and children on early learning activities on a session basis in a local park, in a residential home or at a community hall. The activities focus mainly on the education activities that the parents can do in the home with their children. Playgroups, allow for information sharing between the primary caregivers and parents, and provide a space for supporting them, as well as allowing the parents/caregivers to support each other. These programmes also allow for groups of children, who usually do not interact with many other children, to interact in large groups, on shared activities.

With these programme options in mind, it is important to note that the best way to provide ECD to children, and, in the process to give them the best possible start in life, is by exposing them to an integrated approach to ECD, where comprehensive services and programmes are provided to ensure holistic development of all children. This integrated approach, with coordination between government departments, ECD NPOs, private sector companies, communities, and caregivers, provides optimal results for young children (DoE, DoSD, DoH & UNICEF, 2005).

**ECD teacher training**

Quality teaching and learning is essential for effective early development to take place. Regardless of the situation or the facility in which a child is placed, a quality teacher can provide a learning environment in which a child can develop optimally and in a holistic manner. To produce quality ECD teachers, various training and education opportunities are made available through full ECD qualifications, as well as through short skills programmes. This section explores the ECD qualifications available in South Africa, and describes how these qualifications affect teaching in various ECD facilities.

In South Africa, qualifications are established on the National Qualifications Framework (NQF) by the South African Qualification Authority (SAQA). Training in these ECD qualifications is offered mainly at Further Education and Training (FET) colleges and ECD non-profit organisations (NPOs). To provide a qualification, the service provider/institution must be accredited by the ETDP-SETA (Education, Training and Development Practices Sector Education and Training Authority).

The Department of Social Development (DoSD) and UNICEF have set out the minimum standards for ECD teacher requirements in the document entitled *Guidelines for Early Childhood Development Services* (2006). These guidelines state that the minimum qualification for any ECD practitioner is the NQF Basic Certificate: ECD (Level 1) (DoSD & UNICEF, 2006).
The original purpose of the Basic Certificate: ECD (Level 1) qualification was to provide access to training to teachers who work in an ECD setting (home-based or centre-based) who, previously, may have been excluded from such training opportunities. It aimed to provide teachers with the necessary skills to meet the basic needs of young children in all areas of their development (physical, mental, emotional, and social). However, this qualification has expired (the last enrollment date was 10/01/2010) and is no longer being offered.

The Further Education and Training Certificate: ECD (Level 4) qualification has become the entry-level qualification for ECD practitioners. This qualification provides ECD practitioners with the necessary skills to facilitate the holistic development of young children (including those children with special needs), and offer quality ECD services in a variety of settings (such as at ECD centres, home-based ECD centres, or within community-based services).

The Higher Certificate and National Diploma: ECD (Level 5) qualifications are intended to provide higher education to experienced ECD teachers.

The question of whether or not training in various qualifications actually produces outcomes of quality teaching as required by the DoSD is not clear. While teacher qualification level is often used as a quality indicator for ECD services, higher levels of qualification do not always predict higher levels of quality teaching. This has been found both in South Africa (e.g. Dlamini et al., 1996; DoE, 2001b), and internationally (e.g. Cassidy et al., 2005).

In a recent study assessing the quality of ECD services in the Western Cape, researchers found that qualification level was not always associated with higher quality outcomes, such as quality of care and learning (HSRC, 2009). They also found that only 35% of practitioners responsible for infant and toddler classes had any form of ECD qualification, and only 47% of practitioners responsible for older children had any form of ECD qualification (HSRC, 2009).

There are a number of possible reasons as to why training does not necessarily guarantee quality care and teaching. These could include: a lack of practical demonstration and instruction during training, a lack of on-site support to assist with implementation of theoretical training, and a lack of follow-up support after the completion of training so as to ensure consistent implementation.

In another recent study, conducted in 2011, the researchers found that, throughout South Africa, ECD teachers based in Grade R classes in public schools and those based in community-based facilities are “relatively experienced, and have a fair level of ECD qualification.” (DoBE, DoSD & UNICEF, 2010). They also found that ECD qualification level achieved has a strong association with salary earned. Short courses in ECD and the Basic Certificate: ECD (Level 1) carries minimal financial gains, but ECD certificates at Levels 4 and 5 carry far greater financial gains, with tertiary education in ECD carrying the most financial gain for the teacher.

Table 3 lists ECD qualification figures, by NQF level for April 2005 – July 2006.
The NQF provides a qualification framework for ECD teachers which was previously absent. Moreover, it provides a number of qualifications which all facilitate the improvement of teaching at the Grade R and ECD levels. Finally, the NQF establishes career-pathing opportunities for ECD teachers.

**Institutional Capacity**

According to the Guidelines for Early Childhood Development Services (DoSD & UNICEF, 2006), it is crucial that administrative and management systems are developed and put in place for the effective running of an ECD centre. In order for ECD facilities to adhere to the minimum standards, set by the Department of Social Development, specific processes and structures are required to be in place.

The Tracking Public Expenditure and Assessing Service Quality in Early Childhood Development in South Africa study, (DoBE, DoSD & UNICEF, 2010), showed that community-based ECD facilities in South Africa appear to be less advanced in terms of financial management and governance than that of ECD facilities in the public school system.

The financial management of many of the registered community-based ECD facilities is poor; more than 50% of these sites do not have many of the necessary administrative documents and structures in place, including such items as a petty cash book. The study found that only 70% of community-based ECD facilities had annual financial statements, and of those who were recipients of the DoSD subsidy, only 77% could indicate how much they had received in 2008. Furthermore, only 61% of the facilities who charge centre fees were able to supply evidence on income from fees, and only 36% of all ECD facilities surveyed kept salary disbursement records. Approximately 95% of community-based ECD facilities had a bank account and in very few instances were these bank accounts in the name of the owner or another person involved in the running of the facility (DoBE, DoSD & UNICEF, 2010).

With regards to the governing bodies in community-based ECD facilities, in the majority of cases, a governing body exists and functions well (three percent of facilities do not have a governing body at all) (DoBE, DoSD & UNICEF, 2010).
Encouragingly, the research has shown that the administrative structures within the community-based ECD facilities are fairly good. For example, approximately 90% of community-based schools have correctly completed attendance registers for children indicating that they are in line with this aspect of the minimum standards set by the Department of Social Development.

With regard to ECD facilities within the public school sector, the institutional capacities of public schools appears to be more sophisticated than that within community-based ECD centres and have more structured governance and financial reporting systems. This could be due to the fact that these ECD facilities form part of public schools and that they have close ties with the Department of Education's administration. With their superior institutional capacity, Grade R facilities in public schools are seen as the benchmark for community-based ECD facilities. Evidence indicates that within public schools, the school governing bodies are well established and have effective methods of accountability to parents.

**Funding**

The vast portion of ECD centre funding nation-wide is from parents’ fees. Government funding for ECD comes mainly from the Department of Social Development and the Department of Education at provincial level. There are two primary ways in which the Department of Social Development in each province provides funding to ECD. The first channel of funding is through a subsidy for registered ECD facilities, calculated at R12 per child per day (but varying by province) for those children from birth to four years of age. Some provinces have increased this to R15 per child per day. Only those children whose parent or caregiver’s income falls under a specific level, as assessed by an income means test, qualify for the subsidy. This means that only those ECD facilities that cater to the poorest of families benefit from this subsidy (Giese, Budlender, Berry, Motlatla & Zide, 2011).

The funding and expenditure of various governmental departments and programmes shows that funding for ECD facilities through the subsidy has increased over the last decade from R335 million in 2003/2004 to more than R1 billion in 2011/2012 (Giese, Budlender, Berry, Motlatla & Zide, 2011). While this increase is encouraging, there are significant disparities across the provinces in terms numbers of centres accessing the subsidy, as well as the actual amount they receive, with many ECD centres not receiving the subsidy at all. This could be due to number of factors, including differences in how provinces calculate the subsidy, and a backlog in the registration process.

The second way in which DoSD provides funding for ECD is through programme funding for NPOs for various ECD programmes. These programmes are usually non-centre based models of ECD provisioning, such as family outreach programmes. Funding for non-centre based programmes for NPOs is significantly smaller than funding for centre-based facilities.
There are significant differences in this funding across provinces, although each province is greatly underfunded. NPO programmes that receive funding from DoSD include toy libraries, home visiting programmes and informal playgroups. This funding is often once-off funds for pilot projects. The allocation of funding to centre-based ECD programmes points to a general favouring of this form of ECD provisioning, even though non-centre based programmes have the potential to reach the most vulnerable children not currently being reached.

The Department of Education provides funding to Grade R programmes. The three primary channels of funding are: funding for Grade R in public schools; subsidies for registered community-based Grade R facilities (either in the form of a per child subsidy or as the payment of salaries for Grade R teachers); and funding for training fees and stipends for those ECD practitioners who receive learnerships.

Researchers have found that the share of ECD budget in the total education budget allocated to the DoE has increased from 0.7% in 2006/2007 to 2% in 2012/2013 (Giese, Budlender, Berry, Motlatla & Zide, 2011). Once again, while this increase is encouraging, there are also significant variations in Grade R funding across the provinces, with most of the funding going towards Grade R facilities in public schools.

In the Audit of ECD service quality in South Africa, the Department of Basic Education, Department of Social Development & UNICEF (2011) found that more than half of registered community-based ECD facilities receive funding from DoSD (37.7% receive solely from DoSD, and 19.5% receive from DoSD and DoE), and that almost 40% of facilities receive funding from DoE (20.1% receive funding solely from DoE). In their sample, approximately one quarter of registered community-based facilities (22.6%) receive no funding from either department.

Table 4 illustrates the allocations for early childhood development programmes (including Grade R) in the 2010 budget. The programme accounts for a small share of the overall provincial education budgets.

**Table 4:** Provincial Budgets for Early Childhood Education Programme (R1 000).

<table>
<thead>
<tr>
<th>Province</th>
<th>2010/11</th>
<th>2011/12</th>
<th>2012/13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Cape</td>
<td>528,492</td>
<td>652,168</td>
<td>676,000</td>
</tr>
<tr>
<td>Free State</td>
<td>95,738</td>
<td>100,978</td>
<td>105,717</td>
</tr>
<tr>
<td>Gauteng</td>
<td>55,7541</td>
<td>660,215</td>
<td>679,843</td>
</tr>
<tr>
<td>KwaZulu-Natal</td>
<td>598,678</td>
<td>722,054</td>
<td>758,157</td>
</tr>
<tr>
<td>Limpopo</td>
<td>237,432</td>
<td>249,253</td>
<td>267,750</td>
</tr>
<tr>
<td>Mpumalanga</td>
<td>124,553</td>
<td>155,718</td>
<td>134,667</td>
</tr>
<tr>
<td>Northern Cape</td>
<td>47,930</td>
<td>51,655</td>
<td>55,673</td>
</tr>
<tr>
<td>North West</td>
<td>209,020</td>
<td>224,109</td>
<td>239,553</td>
</tr>
<tr>
<td>Western Cape</td>
<td>342,657</td>
<td>363,593</td>
<td>384,764</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,742,032</td>
<td>3,179,743</td>
<td>3,302,124</td>
</tr>
</tbody>
</table>

* Source: Adapted from Government Funding for Early Childhood Development: Can those who need it get it? (Giese, Budlender, Berry, Motlatla & Zide, 2001).
Conclusion

There has no doubt been an improvement in Grade R and ECD provision over the past 18 years since 1994. The number of children in Grade R has trebled and quality has improved. Government expenditure on Grade R has increased three-fold since 2008/09. The number of ECD centres registered with the national Department of Social Development has increased to 19,500 and there are currently approximately 836,000 children in a registered ECD centre, of which 488,000 (58%) received the ECD subsidy. Many more children are in unregistered ECD centres and no recent survey of ECD provision has been done. However, it is fair to say that much work is still needed, if we want to improve the quality of children’s lives in South Africa.

References


Methodology and theory in a rural ECD research project: Capturing Mogwase in ‘becoming’

Abstract
Conducting research on early education development at rural sites in South Africa is challenging. This is partly because it is difficult to capture the vast array of factors that impact on the lives of people in rural communities. In this article the author reports on some of the difficulties, showing how cultural historical and activity theory (CHAT) can be used as a lens in a participatory action research (PAR) project. The author argues that far from being a negative by-product of development, tension, if managed effectively, could be harnessed as a powerful driving force of change and transformation. The article shows what a daunting task it can be for a researcher to make sense of such a process of transformation, especially amidst the seeming chaos of conflicting voices, dichotomous forces and strong interactions active between the people and aspects within such a situation. Referring to a recently completed study in a rural settlement community, the article concludes that the use of a theoretical framework, such as CHAT, as a heuristic tool, could be valuable in helping researchers make sense of the often complex dynamics of early childhood education development within the specific context of rural community life.

Keywords: rural early childhood development (ECD); participatory action research; community education; cultural historical and activity theory.
Introduction: ECD last on the agenda of educational transformation?

Establishing early childhood development (ECD) at rural sites in South Africa is challenging. This is partly because early childhood and education, young children’s learning, and curriculum and teacher development do not take place in a void, but within specific contexts where various, and often unexpected, dynamics play a role. These intricate processes involve diverse people, who are influenced by a host of other people and by the beliefs, rules and power structures that hold sway in their specific situations (Sen, 1990). The ‘one size fits all’ trends in South African educational provisioning and curriculum development, although intended as a means to ensure more equitable access to education for the poor, in many instances effectively exclude the very children it was intended for (Harley & Wedekind, 2004). Although the funding for schools is formulated according to family income, there is often little evidence of how poor children in marginalised communities benefit specifically. In the light of the effects of globalisation and the contemporary view of education as a commodity (Marginson, 1997; Sen, 2003), it is more important than ever to take note of the local, in trying to see the global. Policy makers, practitioners, and researchers are urged, in this article, to view the provision of education as embedded in the very specific context within which it is being delivered; geographically, socio-culturally, socio-economically, and also politically.

The real situation at rural South African crèches and pre-schools is that of a shortage of just about anything one can mention, which, in most cases, would help to advance the children towards successful school education. Apart from family and parental care, which is assumed children may have, the often overfull centres, with high care-giver to child ratios, need material and human resources, such as stimulating programmes, some learning material and adequately trained practitioners (Grey, 2008). Ngobese (2006) argues that the inability of the often illiterate and poor populations in rural communities to contribute, and the very important part that parents and communities are meant to play in the development and educational progress of their children, exacerbate the challenges of improving rural children’s early development and later school performance. Despite recent initiatives by the Department of Basic Education (DBE), early childhood education provision in South Africa remains problematic, with low access, low programme quality and low levels of teacher qualification being just a few of the challenges faced in this field. Notably, ECD provision still relies heavily on volunteers and non-governmental/community-based organisations. Add to this the lack of comprehensive policy around ECD (Biersteker, 2010; Biersteker & Dawes, 2008; Ngobese, 2006) the long accepted habits and perceptions around child-rearing practices in Africa (Pence & Marfo, 2008), as well as the question of how to proceed towards a workable and effective way of ‘doing’ ECD so that children really benefit, and the field becomes a conundrum, which could possibly take so long to solve that the current generation of young children will quite literally ‘miss the bus’ to a better future.

For the democratic principles in education to truly effect change Maarman (2009) argues, they need to add up to the construction of actual changed realities for learners
in resource-poor settlements. However, the often challenging interplay between aspects of early childhood education provisioning along with diverse perceptions and expectations of different role players within externally implemented community education interventions, frequently cause tensions. These tensions, if not managed effectively, could diminish the possible benefits of ECD for a community (Van der Vyver, 2012). Pressures brought about by everyday aspects of early childhood education implementation, such as the development of a suitable curriculum, the recruiting and training of teachers, and the day to day functioning and management of a pre-school within the existing power structures of a community, all contribute to the complexity of such a situation. Referring to the community of Mogwase, I argue that the tensions are powerful mechanisms for change, but caution that there is a caveat; researchers and development agents in researcher roles should not only have sound empirical knowledge, but also a strong theoretical framework from which to view the work on an ECD site. I propose this not so much as a view to advance theory as much as a view to understand practice (Henning & Gravett, 2011) and thus to scaffold research.

On this view, I argue that tensions, as uncomfortable as they might feel to participants, are necessary for the process of education development to evolve and, if managed properly, could even be seen as the main driving force in such a process (Van der Vyver, 2012). For an ECD project, such as the one to which I refer, to succeed it is important that the different voices of the people of the target community, no matter how disparate, be heard so that tension, as a catalyst for change, can be elicited. As Sergiovanni (1994) proposes, schools are about relationships and effective teaching and learning will come about more naturally if schools are viewed first and foremost as communities of different people in dialogue. Add to that the chronology of attention to educational reform since 1994, and it is clear that primary school, foundation phase and pre-school issues came behind attention to further education and training (FET) and senior phase development programmes. With no public provision for care and education before Grade R, it is reasonable to say that ECD has been the last item on the agenda of transformation of public education and that this, coupled with the role of poverty in education performance, has not bode well for the sector (Van der Berg, 2008).

**A research genre and framework for an ECD inquiry**

In a study about an emergent ECD project it will not come as a surprise that participatory action research (PAR) was employed as part of a research strategy. This approach is one way of managing the (empirically) emerging tensions within the process of establishing early childhood education centre in a rural setting. The hallmark of PAR is that it looks for solutions from the people who are the object of the inquiry (Beukema & Petersen, 2007). Through repeated cycles of planning, action and reflection, a platform is established from which the views of all stakeholders can be aired. This requires the researcher to work empirically while reflecting theoretically. This mode of research and solution-seeking activity could serve as an outlet of often
strong and conflicting views, and as a forum where opinions are put to the table for
discussion and for recording. Simply put, people want and need to be heard when their
communities are ‘being developed’ (Bailur, 2007). And by the same token, researchers
need to reflect on this practice (Beukema & Petersen, 2007) and use new and existing
data to do so.

The shortage of data on almost all aspects in the field of ECD delivery in South
Africa is cited by Biersteker and Dawes (2008) as one of the critical challenges that
need to be addressed. Although some data exist on enrolment and ECD provision by
schools, data on provision and processes of development at stand-alone ECD sites are
disparate. And to gather such data remains challenging. When conducting research
in PAR one has to look for patterns/order in the seeming chaos of tensions that arise
amid bouts of reflection, planning and action.

This is when it could be useful to view the data heuristically, from a different
vantage point. Applying a thinking tool, such as cultural historical and activity theory
(CHAT), could help the researcher retain a specific focus, and make sense of community
education research as a process or activity, instead of considering it as a static situation.
I opted to use this framework and found it very helpful. Having previously studied
classical Vygotskian theory (Kozulin, 1990; Vygotsky, 1986; 1978) I began a process
of familiarising myself with newer theories in this tradition. I was attracted to the
work of Engeström (1987; 1991; 2001), because of its appeal to researchers trying to
understand social systems and their dynamics. Engeström developed his version of
classical Vygotskian cultural historical theory, sometimes also referred to as socio-
cultural theory and Leontiev’s (1978) activity theory, to emphasise the role of tension,
and contestation, in what he refers to as an ‘activity system’. In doing this Beatty &
Feldman (2009) and Beatty (2012), point out that he thereby subsumed sociocultural
(cultural historical) theory and extended ‘the (conceptual) triangle’ that Vygotsky
(Vygotsky, 1978; Kozulin, 1990) used to present his ideas. Vygotsky (1978) proposed
that human activity is mediated by tools and signs and that the object of this activity
is not acted upon without a host of semiotic indicators, such as language, and other
artefacts and tools. One of the main tenets of this more recent theory is its focus on the
interconnectedness between all aspects of a social/‘activity’ system (Beatty & Feldman,
2009). According to this view of human activity, Engeström (1987) proposes that a
systemic perspective on such activity would include different aspects of its context.
De Beer and Henning (2011) make the point that the Russian word for activity is not
directly translatable into English and that the German translation Tätigkeit (‘doingness’)
explains the notion of on-going engagement in a programme of action towards a
specific objective, with a specific motivation, and envisaging a specific outcome.

Thus, in the heuristic of an activity system, and thinking of its various nodes (cf.
Figure 1), the acting/engaging subject, which is the person or group whose actions the
researcher is seeking to understand, uses tools, such as computers, language (a signing
tool), and a curriculum, to move towards the object of the activity and, in doing so, to
(hopefully) produce certain outcomes. The action of the subject is, however, not taking
place in isolation; it is impacted upon by the community, which represents the other stakeholders in the object of the activity. The division of labour within a community also impacts on the action of the subject. It has to do with how tasks are allocated within the community and how the community is stratified around structures of power and status. Coupled with that is rules, which include those regulations, conventions and beliefs valued by the community, and that influence the actions of the subject, its choice of tools, the extent to which it adheres to the notions of the division of labour and its interaction with the community, and so forth. However, as Beatty and Feldman (2009: 18) caution, describing an activity system in isolation is pointless. To understand some of the tensions in a social system where a specific activity is investigated, it too, has to be seen in a wider, systemic context and in an historical gaze. There is, thus, a need for what researchers refer to as a “thick description” (Geertz, 1973: 7 in Ryle, 1949) of the system. The aim of this article is to present such a description of one system and its tensions. The work is thus conceptual and the heuristic device remains no more than an analytical tool. It does not aim to classify empirical reality of the PAR process, but to understand it a little better.

In the thick description of the process of establishing an ECD site at a rural informal settlement, I will first describe the organic nature of such a process, the various tensions that could arise between the different role players as a result of the process, and, briefly, also how these can be managed in PAR mode. I will then show how the application of a heuristic tool, such as the notion of an activity system, can be employed during research to make sense of the seeming chaos of such a process and to give the empirically thick description some theoretical explanation (Geertz, 1973).

Education research in a development context: Moving beyond technical evaluation

This study emanated from social development work in a rural informal settlement in a province in South Africa. The work comprised development in a village settlement and included most aspects of daily living of its 700 inhabitants. Although informal settlements are common around cities and towns, new rural settlements are less common. The changes in everyday village life are not unusual and in this instance, nothing extraordinary took place, except that a pre-school was established, unexpectedly, by the donation of two shipment containers (‘edutainers’). From this, then, a whole new programme of lay teacher development was created and a new curriculum was forged for the emergent pre-school and for the teachers as well.

The project started with only some realisation of the many interrelated factors that challenge the linearity of a simple input-output view of ECD and education in a country like South Africa. There are, for one, different strategic links between public sector departments, such as public health and social development and also basic education. This is, possibly, why the ECD sector was included in the Human Resources Development Report for the first time in 2008 (Biersteker & Dawes, 2008). The authors, who wrote the section on ECD for that document, contend that this indicates
the extent to which the South African government has realised just how essential ECD is for laying the foundation for success in the schooling system and how important it is to introduce, especially those children who come from poor environments, to quality ECD provision.

Prior to the report by Biersteker and Dawes (ibid), there had been some policy development. These authors state that the White Paper (1995) marked the beginning of growing support for ECD as the actual start to the educational journey for the post-apartheid education authorities. The South African Congress for Early Childhood Development (2011), a representative body of national non-government organisations that aims to organise, mobilise and unify the early childhood sector in the country, included ‘research’ and ‘policy development’ as part of its founding aims. This growing focus has highlighted the need for sound education research in the sector. As argued by Biersteker and Dawes (2008) and later also by Biersteker (2010), it is imperative to build knowledge directly from ‘the ground’ to add to our understanding of how communities, donor agencies, development practitioners and the public service can collaborate to care for and prepare young children for school. The shortage of data on almost all aspects in the field of ECD provision in South Africa is cited by Biersteker and Dawes (2008) as one of the critical challenges that need to be addressed. Although some data exist on enrolment and ECD provision by schools, data on provision at stand-alone ECD sites are scarce and also disparate. The recently established South African Research Association for Early Childhood Education (SARAECE), founded by researchers in this field to drive research that goes well beyond project evaluation and mere surveys of sites, is one move in the direction of systematic, co-ordinated research in the field.

There is also a need for sound academic evaluation research that is grounded in theory and that moves beyond output measures. Historically, in South Africa, project evaluation is aimed at showing how well a project is aligned with the aims and objectives set for it by the funding agent and is not conducted from a theoretical position Christie (2003), in a study on the “practice-theory relationship” in evaluation, found that only 36% of studies had a theoretical grounding. In edited volumes of a series, “New Directions for Evaluation” the American Evaluation Association aimed to address this issue. Two of these edited volumes by Stufflebeam (2001), and Caracelli and Preskill (2000) explore the topic further.

Working from a specific theoretical perspective gives a researcher a structured framework from which to assess and interpret the unpredictability and seeming chaos that often characterises the organic process of community education delivery. It is, therefore, important that the researcher acknowledges the various tensions that emerge from the community’s ‘becoming’ in a Deleuzian (cf. Semetsky, 2006) sense. Equally important, and perhaps advisable, is that a researcher brings order to this seeming entropy, at least heuristically, through employing a theoretical framework as organising principle (Christie, 2003). In my own venture into the community of
Mogwase I learned the value of a stable theoretical framework when I entered the maze of community development.

Mogwase – a community ‘becoming’
Mogwase is an informal rural settlement situated 15 kilometres from a small town on the edge of the Gauteng Province of South Africa. The land for the settlement was secured, with the help of local government, by 55 members of the community in 2001. The community thus owns the land, and the settlement is governed, at community level, by a steering committee, and, on a larger scale, by the local regional council. A councillor for the region, appointed by the African National Congress (ANC) serves as link between the steering committee and regional government.

Prior to the introduction of the Extension of Security of Tenure Act (No. 62 of 1997), agricultural workers in the area were extremely vulnerable and often displaced when the land they had been working on changed ownership, or when the nature of the agricultural activity they had been working in changed in such a way that they were no longer employed. The nature of economic pursuits within the area had been changing from pure agriculture to eco-tourism and recreation. Also, where agriculture remains, the mechanisation of farming activities rendered the employment of many unskilled labourers redundant. Many of these displaced unskilled labourers settled at Mogwase in 2000.

First a windmill and then ‘crèche-ing’ at Mogwase
The Mogwase community development project was initiated at the end of January 2008. Through participatory methods, such as transect walks, informal discussions with members of the community, group discussions and the exploration of case studies described by the people of the new community (Binns, Hill & Nel, 1997), the settlement’s most urgent expressed needs (Werner & Bower, 1983: 3) were explored. Discussions with individuals and small groups all pointed to the lack of a constant source of clean drinking water as their most pressing need. However, the legacy of several failed projects that had been implemented by the local government meant that the people of the settlement were very distrustful of outsiders. After careful deliberation, the development practitioners and the community steering committee submitted a proposal to a large corporate funder and succeeded in securing a windmill for the settlement. Although the proposal was accepted, a long process involving months of waiting for paperwork to be finalised ensued. Thus, when, after a long waiting period, the windmill was finally erected in November 2009, it served to instantly unify the people and to bring them to implicitly trust the development practitioners as allies.

Shortly after the erection of the windmill the development practitioners were then approached by a corporate social investment (CSI) manager from an affiliate to the existing corporate funder. She enquired about the status of ECD provisioning in the village and wanted to know whether Mogwase needed a crèche. It turned out that
this prospective funder could assist with the provisioning of an edutainer, which is a shipment container that had been converted to a classroom and which could serve as the location from which an ECD programme could be developed.

Knowing that no need for ECD had been expressed up to that point by the community, but not wanting to pass up on the opportunity to secure the resources for an ECD project, the development practitioners decided on a campaign to create awareness about ECD in the community. After a very short time, during which the village inhabitants were made more aware of the possible benefits an ECD facility would bring to the community, they unanimously agreed that the edutainers would be a good idea.

Tensions arise and participatory action research (PAR) begins

Prompted by the unexpected offer of sponsored ECD provisioning for the community, the development practitioners had, in this one instance, veered away from the people-centred approach, which they had followed up to that point. From this divergence, then, a rather intense and disorderly process of curriculum development and teacher training started. The situation became at times rather chaotic and even volatile as tensions mounted around the crèche, and how it should be implemented at the settlement. Three volunteer mothers started to work at the crèche. As the now designated educational development practitioner, I envisaged the crèche at Mogwase as an entity grown ‘by the community for the community’. I hoped for these young women to be given the chance to ‘work out’ a suitable curriculum for the crèche, by combining their new resources (the edutainers, playground equipment, educational toys and equipment) with their existing indigenous knowledge of ECD. However, this approach resulted in conflict and tension as the teachers acted according to the community’s belief that children should be in the crèche to be ‘kept safe’, and that the volunteers would act in a child-minding capacity and no more. However, the parents demanded that the teachers ‘teach’ their young children to read and write. Also, the volunteer teachers earned a stipend, which, however small it was, constituted a sizable income in a community where only ten percent of people earned any money. This elevated them to the status of ‘top-earners’ in the settlement. These three young women were catapulted into a position of stark opposition to many of the community’s beliefs about young women and their place in that small society. For instance, in Mogwase, young woman have very little status, and grandmothers have the ultimate say over what happens to the children of these mothers.

This ‘failure’ of the lay practitioners to ‘invent’ a suitable curriculum led to the suggestion, by the development practitioners (including myself) and the village committee, that the volunteer teachers needed professional training. As a fluent Setswana speaker I was tasked to start training the teachers, once a week, in the basic principles of ECD, and arranged for them to attend a nearby pre-school once a week to gain some on-the-job experience. This second intervention proved inadequate to address what the community perceived as their children’s early learning needs.
Conflict arose between parents and teachers, as well as the committee and the development agents, as a result of the many opposing views and expectations of what ECD should entail in the settlement. Two incidents of physical violence between parents and teachers resulted in the crèche closing down for two weeks, during which all stakeholders carefully reflected on the situation. It was then decided, collaboratively, that the volunteer teachers needed intensive, day-by-day training, not by a development practitioner, such as myself, but by an external trainer. This proved to be the very thing that was needed for the situation to progress and over a period of a little over a year, the teachers, in collaboration with their trainer, Paulina, and with the input from the parents and the community committee, managed to forge a context-specific curriculum at the site.

**Activity theory as a lens for viewing the Mogwase crèche development**

What had been happening during this time was, in effect, the first phase of a PAR project. To try and understand the systemic dynamic, I utilised CHAT as theoretical framework in a study of the founding of the pre-school to serve as a theoretical gaze, while the PAR developed empirically.

The successful development of an organic curriculum and the training of the teachers at this site were reflected in a number of findings from the study. The main finding was that, despite the many challenges of implementing a society-initiated ECD intervention in a rural community with untrained teachers, it is indeed possible for the community to come to own the intervention. It was also possible for a context-true curriculum to develop organically, with young children using their school tools and the village tools, such as the vegetable gardens and the water reticulation works as learning materials, for example. And for the teachers, there was now the opportunity to progress towards their own professional development in the field of ECD.

Furthermore, the study shows that tensions arising from the implementation of such an intervention, if managed in PAR mode, could provide the necessary impetus for participants to actively look for solutions to the practical problems they face and to facilitate a shift in their paradigm, from one of scarcity, child minding and discord to one of expanded awareness that combines their indigenous knowledge of traditional child care with more systemic concepts of early childhood education and school preparation.

I will now show how I used Beatty and Feldman’s (2009) interpretation of Engeström’s model. I will also show what role the tensions that operated between the different role players and aspects of this intervention played when looking heuristically at the interaction between the different nodes of the activity system.
According to Engeström's model of an activity system (2001, in Beatty & Feldman, 2009), the subject in the activity system is described as the viewpoint of analysis or as the person or sub-group whose actions we seek to understand. The group of volunteer ECD teachers and the development practitioners engaged in the activity of establishing and running the crèche, comprise the unit of analysis within this activity system. They can be seen as the “point of view” of the study or the “person or group whose actions we seek to understand” (ibid: 4).

The object, that which ‘motivates’ the actions of the subject and ‘upon’ which the action is lodged, is the professional development of the volunteer teachers. The outcome of the subject’s acting on the object, of the volunteer teachers undergoing a process of professional development, is the generation of an organic curriculum (within the context of teacher development). The outcome includes the dimension of children who are cared for and who may be ready to enter formal education after they have ‘graduated’ from the crèche.

The subject in an activity system makes use of artefacts/tools to act upon the object in order to bring about the desired outcomes. The tools are ‘mediational means’, and they are inherently semiotic, carrying the norms and signs of the culture, especially as these are embodied in language. These tools can be physical, such as the edutainers and outside play equipment. They can also be cognitive, as in the case of new teaching methods and new professional habits that have been formed. Symbolic tools (signs)
used by the teachers include language and how it is used in the classroom, discourses, pictures, and a curriculum, which is one of the main tools of educational settings, such as this ECD setting.

The notion of community refers to the participants who are engaged in the collective activity with the subject, together with other stakeholders in the object of the activity. The committee, parents, leaders, donor funders, development practitioners, trainers and members of local government all have an interest in the development of ECD within this settlement. They can be said to make up the community within this system. I mentioned, already, that the term activity does not refer to a single act or action, but to the notion of collective ‘doingness’.

The concept of a division of labour within activity systems has a horizontal and vertical component to it. The horizontal division of labour refers to how and by whom certain tasks are carried out in the community, while the vertical division of labour refers to how relationships of power and status are perceived by the members of the community (Centre for Activity Theory and Development Work Research, 2003, in Beatty & Feldman, 2009). This refers to the management and the hierarchical relations within the community. In this case, the relatively low status of young mothers, as perceived by the community, could be said to be an example of both the horizontal and the vertical division of labour in the settlement. The role of young mothers in this settlement is to take care of their children and to assist their own mothers with household chores. When young mothers suddenly become ‘teachers’, and moreover ‘well paid’ teachers, their status is disproportionally elevated, in the view of the community. This causes disequilibrium in the system of which the teachers are part and challenges the existing relationships of power and status.

The rules in an activity system can be ‘implicit’ or unexpressed, such as traditional customs and beliefs, or ‘explicit’ and stated in detail such as policies, laws and regulations. Either way rules shape the behaviour of community members (Beatty & Feldman, 2009). Examples of explicit rules within the activity system of the crèche at Mogwase include rules made by the committee to regulate behaviour within the settlement, the rules of the donor funders regarding expenditure and government policy around the regulation of ECD sites in Gauteng. Implicit rules include beliefs around gender equity, capabilities of young women to look after children, and what constitutes acceptable ECD practice in Mogwase.

**Principles of activity theory in action: The tensions within the ‘activity system’ of a new pre-school**

Engeström and others felt that second-generation activity theory, the iteration after Leontiev’s version of activity theory (Leontiev, 1978), failed to present the interconnectedness of the different aspects or to “understand dialogue, multiple perspectives, and networking’s of individual activity systems” (Engeström, 2001: 135). In using this perspective on the work of a small system in society I found a stable theoretical position from which to observe what I had been experiencing in the harsh
empirical reality of the PAR project, and in which I had become a researcher, after having become a participant by default, due to the donation of the edutainers. I utilised the five main tenets or principles (of this take on activity theory) as heuristic with which to process the development of the crèche project as a scholar of educational development.

The first principle is that “a collective artefact-mediated and objects-orientated activity system, seen in its network relations to other activity systems, is taken as the prime unit of analysis” (Engeström, 2001: 135). This is an important distinction and it comes from classical Vygotskian theory, in which mediated activity is the unit of analysis (Wertsch, 1990). With Engeström’s view, it logically holds that the whole system would be the unit of analysis. And so it was in this project too, that “goal directed individual and group actions” (Engeström, 2001 in Beatty & Feldman, 2009: 4), the actions towards the implementation of the ECD facility and practitioner training in Mogwase, “are relatively independent, but subordinate units of analysis (and that) are eventually understandable only when interpreted against the background of an entire activity system” (ibid). In Mogwase for example, the training experiences of the volunteer practitioners as individuals, and as a group, cannot be viewed apart from the expectations and evaluation of the parents, the community committee, the donor funders, the development practitioners, the trainers or local government authorities. Some would argue that this view of activity is radically systemic and I would concur. But such a theoretical view on a rural informal settlement community’s enterprise helped to clear the air in trying to understand the PAR reality.

The second principle deals with “the multi-voicedness” of activity systems. An activity system always comprises a community of multiple points of view, traditions and interests (ibid: 5). It is evident that in the situation in this study there are indeed vastly different points of view with regard to what constitutes quality ECD practice from the multiplicity of stakeholders in this study. Traditional beliefs and customs around early childhood education and care are standpoints that play an important role within the activity of this system. Lodged within these points of view are, not unexpectedly, multiple tensions. For the somewhat perturbed PAR researcher this was some consolation.

The third principle is ‘historicity’. Activity systems evolve over “lengthy periods of time. Their problems and potentials can only be understood against their own history” (ibid). I list here a few of the historical aspects that affect the activity system in this study. The establishment of the village where the pre-school is situated came about due to the settlement there of 55 farm workers and their families, as a result of their displacement by farmers in the area from agricultural land in response to The Extension of Security of Tenure Act (1997). The land on which the village is situated was then purchased by government on behalf of the residents. Conflict about leadership and other political issues have often flared up leading to poor internal cohesion in this community. The larger community development project, of which the crèche forms part, is another historical factor that impacts on the ‘system’ of the crèche. Events
which transpired before the establishment of the crèche; for example, how the larger project transpired before the establishment of the crèche play a role in perceptions and expectations of the crèche by the different role players; development practitioners, community members, committee members etc., even before the crèche opened its doors for the first time. For example, how the community viewed the authority and trustworthiness of the development agents played a determining role in their decision to accept the donation of the edutainers in the first place.

The fourth principle is “the central role of contradictions as sources of change and development” (Engeström, 2001 in Beatty & Feldman, 2009: 5). According to Engeström (ibid), contradictions cannot be equated with “problems or conflicts”. This is an important distinction. He suggests that these are “structural tensions within and between activity systems”, which “accumulate historically” and which not only “generate disturbances and conflicts”, but also include “innovative attempts to change the activity”. An example of this, taken from the pre-design, or the exploratory phase of the study, would be the contradiction between the traditional beliefs around early childhood care and education and notions, held by members of the community, of what ECD in a contemporary ‘crèche’ set-up should involve. These and other contradictions are some of the major dynamics that played a role in the evolvement of the crèche intervention.

The fifth principle states that the possibility exists for “expansive transformation in activity systems” (ibid) and proposes that “activity systems move through relatively long cycles of qualitative transformations” through which the contradictions of the system intensify. This intensification to “aggravation” causes some individual role players to “begin to question and deviate” from the “established norms” of the activity system (ibid). According to Engeström (ibid) “an expansive transformation is accomplished” when the object and motive of the activity are “reconceptualised” so that a vastly larger array of possibilities is accepted than what was the case in “previous mode of the activity”. An example of such transformations within the activity of establishing the crèche at Mogwase include the transcending, by the teachers, of the discourse of scarcity and child-minding that was prevalent in the community when the crèche first started, to a discourse that reflect their professional growth as teachers. Another example would be the growing collaboration between role players on matters affecting the crèche and the growing political agency of the teachers to take part in the decision-making processes that affect their work. As the project progressed there was evidence of changes in perception by parents and members of the steering committee of teachers’ ability to take care of, and educate, young children, and of the educational benefits that the crèche brought to the community and, ultimately, the community’s ownership of an externally initiated intervention.

As can be seen from the discussion of the components of what constitutes, heuristically, the activity system of the crèche at Mogwase, multiple tensions can be said to exist and are generated by the so-called ‘activity’ between the different ‘nodes’ within the system. In saying this I emphasise that ‘seeing’ these nodes is a heuristic
act, not a classificatory one in any empirical sense (Wardekker, 2008). This means that the conceptual gaze I exercise as a researcher is merely to understand some of the empirical vastness that I see into some patterned/ordered structure. It does not mean that there are empirical instantiations of what I contemplate conceptually. This distinction is often missed in literal applications of theories in education.

Taking the training volunteer teachers as the subject, they can be seen, clearly, at one level, as the focus point for all the activities that take place within the system. Whether or not, and to what extent, the object or outcome of the system is met, depends on the teachers and how they choose to employ the tools at their disposal. It is up to them, for example, to choose which language of instruction they will employ in their teaching practice. Therefore, implicit in their choice and use of the tools exist some tension. They have, on the one hand, the power to make or break the process of achievement, if at all, of the emergent curriculum, and on the other hand they are subject to the influences of all other components of the system. For example, although the community in this instance is challenged by the teachers' new role, to revise their existing view of the rules that hold sway and the accepted division of labour within the community, the tensions that result from this interaction between community, rules and the division of labour is projected by the community onto the teachers, thus influencing, and putting under strain, their actions towards the object.

As already mentioned the development of this pre-school took place in PAR mode, which meant that the teachers could participate, albeit at first from a position of relatively little power, increasingly with more authority, in the process of implementation of the pre-school and its curriculum. As they negotiated their position with regard to the other role players and as they became more assertive in their roles, they gained a greater sense of agency in their own professional lives. As parents' knowledge of ECD and of the role the ECD teacher plays in the development of young children increased through the parent orientation programme, the pressure on the teachers also eased off a bit.

**Conclusion: Where theory and participatory research meet**

I draw a number of conclusions about theory and research in the type of context typified in Mogwase. Firstly, although the views of the different role players in the ECD intervention in this study were often extremely conflicting, their participation in the process of finding better ways to implement the crèche seems to have been the only way for the situation to progress. PAR, by its very nature, is not necessarily a smooth process, but one that is often fraught with tension that causes it to progress, not in linear fashion, but in a cyclical way (Reed, 2004). In a sense, conducting this research in PAR mode created the conditions and ‘space’ for dialogue to take place. In this shared space all the interrelated parts of the school community could participate in the implementation of the pre-school and the development of the curriculum, however haphazard some of the processes proved to be. Indeed, the voice of Ngobese (2006) rings true: the early development of children and the effectiveness
with which early childhood education interventions are implemented and conducted in rural settlements depends on a community’s understanding and support. This understanding and support, I would argue, relies, in turn, on the extent to which all stakeholders are encouraged to voice their concerns and opinions about the crèche, and on the researcher’s ability to maintain a clear view of the situation. Charting the dialogical nature of research conducted in PAR mode, with the help of a theoretical gaze, such as CHAT, can help the researcher gain more clarity on the different dynamics and processes at play in the vortex of research that is coupled with development.

Secondly, in this study it was once more affirmed that the unitary view of community, a notion which is often employed by outsiders, such as development agents (Skogen & Krange, 2003), ignores the existing social stratifications, alliances and power structures within a community (Cleaver, 1999) and assumes a generic ‘community’ phenomenon that is nearly impossible to find in the real world of the twenty-first century. The complex dynamics of the causes and effects of poverty on the ability of the community to understand support and assist children’s learning also intricately, and powerfully, impact on the success of ECD delivery at rural sites. Once again, applying CHAT as a lens through which to ‘gaze’ upon the situation in a study could clarify the various interactions between the more complex aspects of the system, such as the division of labour, to understand, for example, the social stratification, status and constructs of power within a community for the researcher. To this study the theoretical frame brought some rationality to a researchers’ participation.

The third conclusion that I have come to is about the notion of national policy in a country with such a prominent Gini index. A national policy is by virtue an aggregation with a number of contextual exceptions. This, I find somewhat fallacious. A national curriculum and standards for assessment are noble, modernistic ideals. However, together with Cross, Mungadi and Rouhani (2002), I would argue for a realistic and pragmatic approach to early childhood education and concomitant education research – one that would focus clearly on the specific circumstances within which it is to be implemented or conducted, especially at rural sites, which differ geographically and socio-culturally. Most of the circumstances that impact negatively on the effectiveness of rural early childhood education delivery manifest at the nebulous intersect between ‘underdeveloped rural settlement’ and ‘poverty’. A lack of infrastructure, low education and skills levels, unemployment, gender inequity and the effects of the HIV/AIDS epidemic on the family lives of children are just a few of the factors which impact on the daily lives of the poor living in underdeveloped rural settlements, where, like in Mogwase, their first urgent need was simply water. It is precisely this dynamic that requires attention and research in order to fully understand the context of the ECD sites in rural settlements. Through the application of a theoretical framework, such as CHAT, this interplay within an ‘activity system’ was clear. I did not venture to related and larger activity systems to which this small part of the South African reality can be jig-sawed, and to which, heuristically early childhood education at a rural site can connect right up to the Presidency.
I also conclude, fourthly, that conducting research at rural ECD sites is a daunting task, especially if it goes beyond technical evaluation studies (cf. Caracelli & Preskill [2003: 1], who ask for “a reconceptualisation of evaluation use that reflects the diversified and changing landscape of the evaluation discipline.”) However, if one views the forging of a crèche as an activity that takes place at a certain place at a specific time and embedded in a particular way of life then the seeming chaos could be perceived as a thrust by the members of a community towards greater autonomy. What seems like disorder then becomes a reflection of a people striving towards being able to provide for its own education needs. In short, if the researcher takes the dynamic system of the entire activity as the unit of analysis that is being investigated it might render the more contradictory and confusing components of the situation more manageable.

Lastly, I conclude that life in a rural settlement, although not reflected in Western education literature as constituting the typical background from which pre-school children come, is still life for many people. Sound, in-depth research and not just surface-deep evaluation of education development at rural sites is needed if we are to truly address the early education needs of young children from resource-poor rural contexts. I would argue that PAR is an essential component of research into real-life situations and that a theoretical framework such as CHAT could be effectively applied as an important organising principle to help the researcher see the patterns and the order within the seeming chaos that is simply the symptom of a community ‘becoming’.

Acknowledgements
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Endnotes
1. In colloquial discourse the term ‘crèche’ refers to a facility where children are looked after and where pre-school activities take place. I therefore use the terms ‘crèche’ and ‘pre-school’ interchangeably in the study.
2. All names of people and placed have been changed for ethics reasons.
3. There was, up to that point no early childhood education site accessible by the children from the settlement. The closest primary school, offering Grade R, was three kilometres away – too far for pre-school children to walk to – and back every day.
4. This is apart from child support grants that are given to low-income mothers of children under 16 years in South Africa.
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Intekenaars moet ‘n direkte betaling in die volgende bankrekening maak:

Kontak gerus die SAJCE-redaksie vir enige verdere navrae.
Aims and Scope:
The South African Journal of Childhood Education (SAJCE) provides a forum for the dissemination of research in childhood education and development. SAJCE is interdisciplinary in scope and seeks to stimulate the exchange of ideas and current issues about research and practices in a variety of educational settings.

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