

Introducing a child-centered numeracy play-center intervention in three rural preschools in Dennilton, South Africa.



Universiteit Utrecht

**NDLOVU
CARE GROUP**



Master-thesis

Project: Preschool project Ndlovu Care Group

By: E. M. Hoppenbrouwer – 3111369

Supervisors: Drs. P. L. M. Baar, Prof. Dr. P. P. M. Leseman

Abstract

Preschool education can prevent the loss of potential in vulnerable children in developing countries. The quality of preschool education is important, and child-centered education can improve this quality. Therefore, a numeracy play-center was established in three South African preschools. The aim of this study was to observe teacher-child interaction during the intervention, and to test differences in children's cognitive and numeracy skills after the intervention. The study included 56 children ($M_{age} = 44.18$ months, $SD_{age} = 5.53$) and 9 teachers from three preschools in Dennilton, South Africa. Cognitive skills were measured by the AWMA, Visual Search, Shape Stroop and the PPVT. Numeracy skills were measured by two numeracy tests. Teacher-child interaction was measured by observations during numeracy activities and was scored with the CLASS scoringslist. Before the intervention, the children at the three preschools scored significantly different on three cognitive tests. After the intervention, the tested children scored higher on short term memory and inhibition. All the children had a significant improvement in their numeracy skills. In the Ndlovu preschools, the teacher-child interaction was improved in the last couple of observations. This study stresses the importance of child-centered education in numeracy learning. It has a positive influence on the numeracy skills of children and the teacher-child interaction. Improvement and continuation of the intervention is needed, so that children will experience the benefits from it throughout their future educational years.

Key words: childcentered, cognitive and numeracy skills, interaction, preschools, South Africa.

Date: June 27, 2011

University Utrecht – Faculty Social Sciences, Department Educational Science

Master Social Education and Youth Policy

Specialization Education, Youth and International Humanitarian Cooperation and Aid

Introduction

A great number of children under the age of five in developing countries, such as South Africa, are at risk for poverty, malnutrition, a bad health condition and a non-stimulating home environment (Grantham-McGregor, Cheung, & Cueto, 2007). Poverty has a negative influence on the development of a child. Young children living in poverty tend to score under the national norms of cognitive skills (Black, Hess, & Berenson-Howard, 2000). These children will have poor school performances and are more likely to transfer poverty to the next generation. Children who do poorly at school are associated with a lower income as an adult and it even can have limitations for national development (Grantham-McGregor et al., 2007). Early intervention programs and preschool education for young children can prevent the loss of potential in vulnerable children (Grantham-McGregor et al., 2007) and can have positive long-lasting effects on child's development (Reynolds, Temple, & Ou, 2010). Liddell and Rae (2001) also found that school readiness in South African children enhances school performance and decreased the number of dropouts, grade retentions, and absences in primary education. According to Melhuish and colleagues (2008), preschool education for children is very beneficial. It helps disadvantaged children to achieve more academic skills at the start of schooling and is of positive influence on their future educational achievements. It also increases the cognitive skills during the educational years and predicts future non-delinquent behavior (Reynolds et al., 2010). During their preschool years, an estimated 16% of the 7 million South African children between 0 and 6 years, are getting formal education (Tempelman, Slabbert, Gosling, & Vermeer, 2010). In poor communities there are many adults who do not have enough knowledge about the importance of child's development, learning, play and of being responsiveness towards a child. If children do not attend a preschool, they often experience a shortage of attention and learning experiences outside their direct environment, and most of them do not have enough educational materials at home (Tempelman et al., 2010).

Previous findings indicate that early development programs, such as preschool education, are beneficial for the development of children. For this reason, the Ndlovu Care Group started preschool education in 1994, for children in the rural township of Dennilton in South Africa. The Ndlovu Care Group divides their activities into the Community Health Care and the Community Development Programs (Ndlovu Care Group, nd.). The Ndlovu preschools belong to the last program. These preschools provide early childhood education, monitor the development of the children, and prevent malnourishment in young children and their siblings (Tempelman et al., 2010). Van der Raadt (2010) found that Ndlovu preschool

children had a significant higher score on cognitive tests than non-preschool children. It can thus be concluded that Ndlovu preschool education is beneficial for the cognitive development of children. However, Van der Laan (2010) found that the Ndlovu preschools had a limited quality, which was caused by a lack of materials, insufficient social-emotional and visual stimulation, and no sensitivity towards the needs of caregivers and teachers. The culture of the teachers and their ideas of childcare was of influence on this (Van der Laan, 2010). She concluded that implementing a child-centered education, such as Reggio Emilia, would be difficult, but that it could be very beneficial for the development of these children (Van der Laan, 2010). Research has shown that children in a playful, child-centered educational environment, do better in tests of mathematics, reading, language and writing, compared to children in a classroom with a less playful, more teacher-directed approach (Hirsh-Pasek & Golinkoff, 2008). For example, children in a preschool with more engagement from the children and with a more child-centered classroom environment, have higher academic achievements at primary school (Hirsh-Pasek & Golinkoff, 2008).

Aim of this study

To establish a more child-centered learning environment in the Ndlovu preschools, a numeracy play-center intervention was implemented in two Ndlovu preschools (Tholulwazi and Kopanang), and one privately owned preschool with governmental support (Mma-larato). The effect of this intervention, on the cognitive and numeracy skills of the children and on the teacher-child interaction, was measured. The overall aim of this study was to increase the preschools quality. The intervention of this study was based on the results of Van der Laan (2010), and aims to put the outcomes of her study into practice by implementing a child-centered intervention in the preschools. It was important to examine if the children's cognitive skills, numeracy skills and teacher-child interaction were improved after the intervention. This study was an expansion of previous research about preschool education and offers more information about the influence of child-centered education on the quality of preschools. It is also important for the South African society, because as mentioned previously, the preschool quality influences children's educational attainment, which is of influence on national development (Grantham-McGregor et al., 2007). Factors that enhance the preschool quality includes the educational level of the teachers (Dowsett, Huston, Imes, & Gennetian, 2008), the preschool type (Sammons et al., 2003), the teacher-child ratio (Pianta et al., 2005), the access of children to use appropriate educational materials (Pianta, La Paro, Payne, Cox, & Bradley, 2002), emotional supportive, warm and positive teacher-child interactions (Pianta et

al., 2005), cognitive stimulation and language interactions in the classroom (La Paro, Pianta, & Stuhlman, 2004). If these variables of preschool quality are high, it enhances childrens' social and academic school readiness and developmental outcomes (Malmberg, Mwaura, & Sylvaa, 2011).

Child-centered educational approaches, such as Montessori and Reggio Emilia, were an example for the intervention in this study. In recent years, there is much recognition for these new ideas of early childhood education. In Montessori education, the child is seen as an active creator for his or her own development. The curiosity and sensitivity of a child determines what he or she wants to learn (Edwards, 2002). The teacher lets the children use materials and does activities which fit the childs' needs. Montessori education includes orderly and pleasant classrooms, where children can be themselves and learn what they are interested in (Edwards, 2002). Another new idea of education is the Reggio Emilia approach. This approach is based on an unique image of the child and can be adjusted to the culture of implementation (Hewett, 2001). In the Reggio Emilia approach, a child has three learning factors: the teacher, the peers and the environment (Strong-Wilson & Ellis, 2007). For the exploration of the world around them, children can learn from peers and their teacher in a cognitive and social-emotional way (Meeuwig, Schepers, & Van der Werf, 2007). According to Reggio Emilia, a teacher must have an attitude of an investigator and let children learn from each other. They must stimulate children to develop ideas, think about how things work (Meeuwig et al., 2007), and guide children in this learning process (Reynolds, 1998). The Reggio Emilia classroom environment includes experiences and materials with learning possibilities for children. The space-arrangement and the materials must be advantageous for children's exploring and investigation (Meeuwig et al., 2007). The interaction of a child with his or her environment leads to child's learning and development. In the Reggio Emilia approach play is an important activity for children (Reynolds, 1998), and is seen as a dimension of learning (Samuelsson & Carlsson, 2008). To make the environment more stimulating for children, the Reggio Emilia uses play-centers. These play-centers have toys with a variation of materials and functions (Meeuwig et al., 2007). Child-centered approaches of education were an example for the numeracy play-center intervention discussed in this study.

Cognitive skills of preschool children

The first and second aim of the present study contains the cognitive skills of the preschool children. The first aim of the study was to observe differences in the cognitive skills

of the children at the three preschools before the intervention. The second aim was to test the children from Mma-larato preschool, before and after the intervention, to measure improvement in their cognitive skills. During infancy and the preschool years, important elements of executive functioning develops. This development is the foundation for the cognitive processes later in life (Garon, 2008). Executive functioning is the capacity that let us control our attention and behaviour, to remember more than one thing and to make a planning (Blakemore & Frith, 2006). Executive functioning skills includes inhibition, attention and the working memory. The prefrontal cortex plays an important role in the development of these functions (Zelazo, Carter, Reznick, & Frye, 1997). Inhibition develops gradually throughout childhood and adolescence. It is this inhibitory control that stops us from saying or doing exactly what we feel all the time. Young children, with an undeveloped prefrontal cortex, find it more difficult to inhibit their behaviour and they act more impulsively (Blakemore & Frith, 2006). Attention is often described as the ability to engage, maintain, loose, and shift focus (Mirsky, 1996; Posner & Petersen, 1990). Attention also develops gradually until adulthood (Blakemore & Frith, 2006). Working memory also belongs to the executive functions. It develops early in life and allows us to hold and manipulate information. Due to the working memory, a person can remember information while doing something else (Blakemore & Frith, 2006). The prefrontal cortex plays a role in holding memories for a short period of time time and develops throughout childhood and adolescence. The development of the prefrontal cortex influences the achievement on memory tests (Blakemore & Frith, 2006).

Another dimension of cognitive development in children, is language development. Language is a cognitive skill that develops in the early years of childhood. Language, which includes sounds, grammar and vocabulary, is developed by using intense learning devices that help children to learn by listening to and interacting with adults and peers (Blakemore & Frith, 2006). Worldwide, many children are learning more than one language. Because of the worldwide superiority of English, millions of people are currently learning English as a second language (Blakemore & Frith, 2006). The preschool children in South Africa have to speak English when they are going to attend the primary school. Therefore, the children's level of English language is important for school readiness.

The preschool years are an important period for the development of executive functions (Blair, 2002). According to Bronfenbrenner (1977), the environment plays an important role in children's behavior and development. Development is seen as an interactive process between the individual and the environment. As pointed out by Bronfenbrenner

(1977), the preschool environment, the teacher and the peers influences a child's (cognitive) development. Other research also supports the fact that preschool influences the cognitive development of a child. Mwaura, Sylva, and Malmberg (2008) found that children who attended preschool enhanced their (non) verbal and numeracy cognitive school readiness skills. According to Vygotsky (1978), more complex cognitive activity in children is stimulated through social activity with adults and peers. The quality of the preschool is important for the cognitive development in children. It is found that 15 to 30% of the variability in children's cognitive activities, is predicted by positive social interactions with the teacher, secure teacher-child attachment, and participation in creative play activities. This is found for all children, regardless of their ethnic backgrounds and cultures (Howes & Smith, 1995). The higher the preschool quality, the higher the cognitive development of children (Burchinal et al., 2000). The teacher-child interaction also has an important influence on the cognitive development of children (Bennet, Wood, & Rogers, 1997). For instance, the intervention of a teacher in children's play activities, can promote specific play abilities, which enhances social, cognitive and language development.

The hypothesis of the first aim, was that the children from the Ndlovu preschools would score higher on cognitive skills than the children from Mma-lerato preschool. This is because the quality of the Ndlovu preschools was expected to be higher. This hypothesis was in line with previous research indicating that preschool quality was associated with more cognitive development in children (Burchinal et al., 2000). The hypothesis of the second aim, was that the children from Mma-lerato preschool would score higher on the cognitive tests after the intervention. This was expected because a child-centered intervention with a focus on positive teacher-child interaction, enhances the cognitive skills of children (Howes & Smit, 1995).

Interaction between the teacher and the children

The third aim of this study was to observe if the teacher-child interaction was improved during the intervention. Many teachers in South Africa are still not prepared enough for teaching and do not have the knowledge of the importance of play for child's development and how to use it in an educational manner (Talbot & Thornton, 2009). In a study of Van der Laan (2010) it was concluded that the Ndlovu preschool teachers used a teacher-directive way of teaching. A more child-centered, democratic approach, such as Reggio Emilia and Montessori, is found to be beneficial for preschool children (Hirsh-Pasek & Golinkoff, 2008). Preschools with a democratic approach and involvement of the children, are more

harmonious, have better teacher-child relationships and are a more adequate environment for child's learning (Landsdown, 2001). The differences between a child-centered education and a teacher-directive education, is that in a child-centered classroom, the child's own interest and learning creations are used, and he or she can choose from various classroom activities (Tzuo, 2007). In a teacher-directive classroom, teachers have more control over the child's learning experiences. However in child-centered education, the teachers are still guiding children's learning (Tzuo, 2007). The teacher-child relationship is important, because it influences the school-readiness of children. Close teacher-child relationships predict more school-readiness, and dependent or conflictive relationships predict less school readiness and increased school-adjustment problems (Birch & Ladd, 1997). According to Pianta, La Paro, and Hamre (2006), classroom quality depends on three domains, namely, emotional support, group organization and didactic support. The first domain includes a positive climate, a negative climate, sensitivity of the teacher and child-centeredness. The second domain includes behaviour regulation, educative activities and productivity, and the third domain contains quality of feedback, language support and concept development. In the following section, these items of the classroom quality domains will be explained.

According to Pianta and colleagues (2005), warm and emotional supportive teacher-child relationships, are significant for the developmental outcomes of children. Positive teacher-child interactions are for an important part influenced by the sensitivity of the teacher towards the children. Sensitivity is the ability to recognize a child's needs and to approach a child positively, with the aim to enhance child's learning and development. Teacher's sensitivity is a significant contribution to a positive teacher-child interaction, which influences preschool quality (La Paro, Pianta, & Stuhlman, 2004). In contrast, teacher's negativity is not beneficial for the development of children. The stress level of teachers can negatively influence their interactions with the children (Yoon, 2002). These negative interactions can create conflicts and lack of understanding between the teacher and the child (Yoon, 2002). Behavior regulation is also an important factor in teacher-child interaction, which influence a child's development. Duckworth and Seligman (2005) concluded that children's self-regulation of behaviour influences their academic achievements more than their IQ does. At primary school, teachers are important in managing children's (disruptive) behaviour (Sutherland & Oswald 2005). Adequate behavior management techniques, such as clear expectations, rules, consequences, and the use of rewards, such as praise, can enhance appropriate behavior and can decline disruptive behavior in the classroom (Sutherland et al., 2000; Sutherland et al., 2008). Feedback from teachers during educational tasks is also

important to enhance child's learning. This feedback include evaluating and judging a child's work or performance with the aim to improve his or her educational achievements (Tunstall & Gipps, 1996). Teachers also have to pay attention to the development of vocabulary and language in preschool children, because it plays a significant role in learning to read (Wasik, 2010). Training teachers to speak with children and enhance their language development, can lead to more opportunities to speak, new vocabulary learning and to the developing of descriptive language in children (Dickinson & Tabors, 2001).

The above items of teacher-child interaction are important to create a high quality preschool, were children from disadvantage homes can benefit from the positive and secure relationships with the teachers. This enhances the children's social and emotional development, school readiness (Peisner-Feinberg et al., 2001), and can be a protective factor for children at risk for dropping out of school (Hamre & Pianta, 2005). Furthermore, Burchinal et al. (2002) found that the interaction between family background and teacher-child relationship, predicts academic success in children. Howes and Smith (1995) concluded that teacher's skills are more important than the overall classroom quality. However, the classroom quality influences the construction of activities and relationships (Howes & Smith, 1995).

The teacher-child interaction is influenced by environmental quality factors in the preschool classroom. In a classroom with a low teacher-child ratio, the teacher would react more sensitively (Phillipsen, Burchinal, Howes, and Cryer, 1997) and positively towards the children (Kontos & Fiene, 1987). More educated and trained teachers are likely to be more sensitive and have a higher classroom quality (Phillipsen et al., 1997). The interaction of the teachers with the children is also culturally dependent. Cultural, economic, and linguistic diversity, influences teacher's beliefs and interactions about and with children (Rimm-Kaufman, Pianta, & Cox, 2000; Wishard, Shivers, Howes, & Ritchie, 2003). It is therefore important to keep this in mind, while implementing the intervention of this study in a non-western environment such as the South African preschools.

Teacher-training to enhance positive teacher-child interaction, was found to be beneficial in different studies. Lyon and colleagues (2009) found that teachers who participated in teacher-child interaction training, improved their positive interaction. This training was weekly for a period of two months and the teachers received feedback and coaching about their interaction towards the children. In a study of Fukkink and Tavecchio (2010) it was found that the use of video-observations in teacher-trainings was beneficial in enhancing teacher's interactions skills. In this training, the teachers were observed with a

video camera and the analyses of the observations were discussed with the teachers. After his training, the sensitivity and responsiveness of the teachers were enhanced and authoritarian behavior was decreased (Fukkink & Tavecchio, 2010).

The hypothesis with respect to the aim was, that during the intervention the teachers would improve their teacher-child interaction. This would improve because of the teacher meetings where the teachers would receive feedback about their interaction towards the children. This is in line with the discussed studies of Lyon and colleagues (2009) and Fukking and Tavecchio (2010), which found that such teacher-trainings were beneficial for the teacher-child interaction.

Numeracy skills of preschool children

The fourth aim of this study was to see if the children in the three preschools improved their numeracy skills after the numeracy intervention. Prior research suggests that learning mathematics for young children in South Africa is necessary. More specifically, an international study concluded that South Africa had the lowest scores of 50 countries on mathematic skills of young adolescents (Ladders out of poverty, 2006). Understanding mathematical concepts, which are related to number sense, starts in early childhood. Early childhood classrooms can be a foundation for mathematical skills needed later in life (Linder, Powers-Costello, & Stegelin, 1998). When children are around three years old, they start counting and applying numbers to objects (“I have four toys”) and actions (“I have jumped three times”). Numeracy in young children contains of different domains. The first one is knowledge of numbers. This contains learning numbers, the number-line and quantities. Knowledge of numbers is something that young children learn gradually during childhood. Dealing with the number-line is fundamental for knowing numbers and learning to count (Koerhuis, 2010). Also other comparisons are important in this domain, such as recognizing smaller, bigger, previous and next. The second domain of numeracy is measuring, which includes comparing and ordering objects with different lengths, contours, volumes and weights (Koerhuis, 2010). The third domain is geometry, and focuses on the orientation, localization and establishing of shapes and figures. This includes comparing, recognizing, naming and sorting geometrical basic shapes, based on their characteristics (Koerhuis, 2010).

When a child is four or five years old, it starts to get a deeper understanding of counting through informal teaching by parents and siblings, and formally by teachers at school. This informal and formal teaching of counting is an example of cultural transmission (Blakemore & Frith, 2005). When children start with primary school, they have different

levels of numeracy (Case, Griffin, & Kelly, 2001). For example, Starkey and Klein (2000) found significant differences between low income and middle income preschool children in their number, counting, and comparing skills. These differences in numeracy abilities in young children predicts mathematical achievements during primary school (Daley & Lefevre, 1997). Preschool education can be an important mutual environment for the learning of numeracy (Blevins-Knabe, 2008). Geary, Bow-Thomas, Liu, and Siegler (1996) also found proof for the importance of preschool education in numeracy development. They made cross cultural comparisons of early counting and other arithmetic abilities, from which they concluded that early differences in counting and other numeracy skills could be explained due to the amount or types of numeracy experiences the children had during their preschool years (Benigno & Ellis, 2004).

In sum, preschool education is important for the numeracy development of young children. To improve the numeracy achievements of children, their motivation and interest towards the subject is very important (Gottfried, 1990; Wigfield & Eccles, 2000). Children's early experiences of numeracy and mathematics, are important for the motivation towards learning it. If a child is successful in numeracy, it increases the chance that he or she likes it. This is likely influenced by the positive feedback, which those children receive from their teacher (Gottfried, 1990; Wigfield & Eccles, 2000). It is important to create numeracy and mathematical learning environments, where children's positive attitudes and motivation towards it are actively stimulated by the teacher (De Corte, 1995). According to Dobbs, Doctoroff, and Fisher (2003) it is important that a teacher uses enthusiastic praise towards a child's achievement. Praise enhances the development of positivity in a child about his or her own capacities. A child's idea about their self-efficacy and the positive feedback of teachers towards child's achievement, are significant factors for being successful in numeracy and mathematic (Dobbs, Doctoroff, & Fisher, 2003). Furthermore, it is important to make numeracy and mathematics relevant for children and to integrate it in everyday classroom activities. Those activities have to be fun and interesting for the children and must focus on increasing children's knowledge and skills about numeracy (Dobbs, Doctoroff, & Fisher, 2003). The previous studies indicate that by doing more child-centered numeracy activities during the intervention, the children will be more motivated towards numeracy learning (Wigfield & Eccles, 2000). According to Dobbs, Doctoroff, and Fisher (2003), positive feedback of a teacher, is important for numeracy learning in children. In line with the above studies, the hypothesis of the aim was that the children in the preschools had improved their numeracy skills after the intervention, because of the child-centered numeracy activities,

which enhance the children's motivation, and because of the increased attention to positive teacher-child interaction.

Overview of research questions

This study examined the aspects that are changed in the preschools because of the numeracy play-center intervention. From the four aims described in the previous section, the following research questions were derived: (1) Are there differences between the children in the three preschools in their cognitive skills before the intervention? (2) Are there improvements in the cognitive skills after the numeracy intervention in the children at Mma-larato preschool? (3) Are there improvements in the teacher-child interaction during the intervention? (4) Are there improvements in the numeracy skills of the children in the three preschools after the intervention?

In short, the following hypotheses were proposed for the questions: (1) The Mma-larato children score lower on the cognitive tests before the intervention than the children at Tholulwazi and Kopanang preschool; (2) The children at Mma-larato preschool are expected to score higher on the cognitive tests after the intervention; (3) The teacher-child interaction is expected to improve during the numeracy intervention; (4) The numeracy skills of the children at the three preschools are expected to improve after the numeracy intervention.

Method

Participants

56 children of 3 and 4 years old and 9 teachers participated in the intervention. There were 25 boys and 31 girls ($M_{\text{age}} = 44.18$ months, $SD_{\text{age}} = 5.53$). Ages varied between 33 and 55 months. The children and teachers went to three preschools in the township of Dennilton. Two of the preschools, Tholulwazi (N=21) and Kopanang (N=13), belong to the Ndlovu Care Group. The third one, Mma-larato (N=22), is a privately owned preschool with governmental support. The teachers all had a degree in early education, varying from grade 1 till grade 5.

Measures

Dependent variables

For testing the children at Mma-larato preschool on their cognitive skills, different tests were used. The same tests were also used by Van der Raadt (2010) when she tested the Ndlovu preschool children last year. *Executive functions* were measured with different tests. To measure inhibition in the children, the Shape Stroop (Garon et al., 2008) was used. In this

test a child sees two different big animals. In these big animals, a different small animal is placed. In the Shape Stroop, the child has to point to a specific small animal. However, from the same small animal there is also a big one. If the child pointed towards a big animal instead of the small one, he or she has a lower score on inhibition. Before the test started, the child had to do the practice, which tested their knowledge about the difference between a small and big animal. If the child completed this practice correctly, the test could start. The value of the Cronbach's α was found to be .66, which is average to high (Field, 2005). To measure attention in the children, the Visual Search (Enns & Cameron, 1987) was used. The Visual Search had three test items. In the test items there were elephants and other animals which looked similar to the elephants. During the test the child had to point to all the elephants in the picture as fast as possible. The elephants were hidden between other animals with many similarities. The child had one minute to find as many elephants as possible, with a maximum of three. The more elephants a child found (maximum of three per test), the higher the score on attention. Cronbach's α for the number of elephants that were found was high, with a value of .72 (Field, 2005). To measure the working memory of the children, three tests of the Automatic Working Memory Assessment (AWMA) (Alloway, 2004; Alloway et al., 2008) were used. These tests were the digital recall, the non-word recall and the odd one out. In study of Alloway and colleagues (2008) it was concluded that the AWMA was a reliable test for measuring the working memory in children. In the digit recall children had to repeat digits. Every round the number of digits would increase. The child had six chances to correctly repeat the digits, and went to the next round if he or she could repeat all the digits in the correct order for four times. The test stopped if a child had three incorrect answers. The more numbers and times a child could repeat correctly, the higher the working memory score. Verbal short-term memory was tested by the non-word recall test (Messer et al., 2010). The non-word recall test had the same principles as the digit recall test. However this test consists of non-existing words, which became more every round. The child had to repeat these non-existing words correctly and in the right order. The third test that was used is the odd one out test, which measures two aspects. The first aspect is the recognition of the odd shape. There were three boxes with three shapes and one of these shapes was different. The child must point to the shape that was different from the other two. The second aspect contains the working memory. For this aspect the child had to remember the boxes where the odd one out shapes were, and had to point to the correct empty boxes in the right order. In every following round, the child had to remember one extra odd shape. The test stopped if the child made three mistakes.

To measure *language development* in the children, the Peabody Picture Vocabulary Test (PPVT) and the AWMA, non-word recall test were used. The last test is already explained in the executive functions part. The PPVT was found to be reliable for preschool children and it also has a high content validity (Dunn & Dunn, 1997). In the test, the child heard an English word and had to point to the matching picture. If a child had 8 or more mistakes, the test stopped. To get the scores of a child, the number of errors was deducted of the sum of items a child had completed.

To measure the *numeracy skills* of the children, two numeracy tests, designed for toddlers, were used. These tests were acquired from the Department of Special Education of the University of Utrecht in the Netherlands. They were based on the numeracy knowledge of young children in kindergarten. The same numeracy aspects as mentioned in Koerhuis (2010) were practices in these tests. For testing the knowledge of the children about counting, numbers, measuring and shapes, the 'Numbers and Shapes task' was used. This test contains of 15 items with pictures. The child had to point to the picture which belongs to the question, such as "where are 4 ducks?" and "where is the smallest boy?". In Item 9 till 12 the child had to count aloud or show with their fingers how many objects they counted on the picture. In the last items the child had to recognize certain geometry shapes. The value of the Cronbach's α for this test was found to be .66, which can be categorized as average to high (Field, 2005). For testing knowledge of quantities, the 'Comparing Quantities Version 4', was used. This test had 12 items and in every item the child had to point to one out of the two pictures with the most cookies. The child also had to recognize the difference between many small cookies and fewer large cookies. The value of Cronbach's α for this test was found to be average to high with a value of .66 (Field, 2005).

During the implementation of the numeracy play-center intervention, observations were made with a video-camera. The focus of these observations lied on the teacher-child interaction. To measure changes in the *teacher-child interaction*, the Classroom Assessment Scoring System (CLASS) was used (Pianta, la Paro, & Hamre, 2006). The CLASS is an observation instrument for measuring preschool quality and is found to be a reliable scoring scale with a high Cronbach's alpha of .94 (Field, 2005). The CLASS dimensions enhances the preschool quality, because they are of influence on children's achievement and social functioning in the preschool (Howes et al., 2008). The CLASS dimensions are based on the interactions between the teachers and the children and the use of materials by the teachers. According to Pianta, La Paro, and Hamre (2006), classroom quality depends on three domains, namely emotional support, group organization and didactic support. These domains

include the following items: positivity, negativity, sensitivity, child-centeredness, behavioral regulation, feedback and language stimulation. These items were scored by a scale ranging from 1 (very low) to 7 (very high). Because the items were scored with the use of a scale, it was needed to change the values of the item 'negativity'. The numbers on the scale of 'negativity' were turned around, so that a score of 1 meant very much negativity and a score of 7 meant no negativity. This item was then called 'absence of negativity'. Because of this a very high score on 'the absence of negativity' was positive for the teacher-child interaction. A high mean score on all the items, meant a good teacher-child interaction.

Independent variables:

Testperiod: To observe differences after the intervention, the scores before the intervention were noted as 1 and the scores after the intervention were noted as 2.

Preschool: To compare the three preschools, they were given different numbers: Tholulwazi (1), Kopanang (2) and Mma-lerato (3).

Procedure

For a period of four months, three numeracy play-centers were implemented in three preschools in Dennilton, South Africa. Van der Raadt (2010) already did a baseline study on the cognitive level of the children at the Ndlovu preschools. Mma-lerato preschool, still needed this baseline study before the intervention could start. Some of these cognitive tests were computer based, but because the children were not used to computers, they got distracted. That is why all the children were tested with paper tests. The Ndlovu coordinator who tested the children was already trained in doing this, because she also tested some of the children in the study of Van der Raadt (2010). If the children needed some knowledge to do particular tests, this would be practiced with the children until they were able to do it. This was to avoid external differences and it was needed to make comparisons between the different groups. So before the intervention, the children of Mma-lerato preschool, were tested on their cognitive skills and the children of all the three preschools, were tested on their numeracy skills. Furthermore, two baseline observations, with focus on teacher-child interaction during numeracy activities, were made in the classroom. After these baseline tests and observations, the implementation of the numeracy play-centers could start. Educational materials were bought with funding from Ndlovu Care Group. In every preschool, a numeracy play-center was established in a classroom corner. To give the teachers inspiration for appropriate numeracy activities for 3-4 year old children, the teachers were given a little

book with seven child-centered numeracy activities, guided by the teachers. These activities included counting, numbers, shapes, quantities and measuring. The numeracy activities were observed every two weeks with a video camera for 15 minutes. The focus of these observations lied on the teacher-child interaction. Every two weeks there was a teacher-meeting to discuss the observed video-material and the progress of the intervention and the interaction of the teachers towards the children. During these teacher-meetings, the teachers could give feedback and exchanges their ideas about the numeracy activities. The teachers were also given feedback about their interaction towards the children. At the end of the intervention, the possible changes in numeracy skills of the children were measured through the same numeracy tests as before the intervention. The children from Mma-lerato preschool were also tested again on their cognitive skills after the intervention, in order to observe possible differences.

All the test scores of the children were imputed in SPSS. To compare the baseline cognitive skills of the children of Mma-lerato preschool with the children of Tholulwazi and Kopanang preschool, analysis of variance (ANOVA) was used for every test. The mean scores on the cognitive tests of the Mma-lerato children, before and after the intervention, were analysed with a paired sample t-test. To compare the children's mean scores on the numeracy tests before the intervention, ANOVA was used. To observe differences after the intervention on the mean numeracy tests scores, the scores before and after the intervention were analysed with a paired sample t-test. For the cognitive and numeracy tests, the effect sizes were calculated for every result, because the sample sizes in this study were relatively small. To analyse the seven observations of teacher-child interaction in the three preschools, the mean scores on the different CLASS items were compared with the use of SPSS.

Results

Cognitive tests

Before the intervention, the children of the three preschools scored significantly different from each other on the PVTT, which tested English vocabulary $F(2, 82) = 22.32, p < .05$. The effect size of this result was large ($r = .60$). With the use of a post-hoc test, it became clear that Kopanang ($M = 15.31, SD = 1.51$) had a significant higher score than Tholulwazi and Mma-lerato. Tholulwazi ($M = 8.20, SD = 1.40$) had a significant lower score than Kopanang and a significant higher score than Mma-lerato, and Mma-lerato had a significant lower score than the Ndlovu preschools ($M = 4.09, SD = 2.86$). There was a significant difference between the preschools in their digit recall score, which tested the working

memory. $F(2, 71) = 19.53, p < .05$. The effect size of this result was large ($r = .60$). With the use of a post-hoc test, it became clear that the children of Mma-Larato ($M = 13.73, SD = 2.85$) scored significant lower on this tests than the children of Tholulwazi ($M = 19.60, SD = 2,74$) and Kopanang ($M = 19.81, SD = 4.76$). The children of Mma-Lerato ($M = 9.45, SD = 2.37$) scored also significant lower on the non-word recall test, which tested verbal short-term memory, than the children at Tholulwazi ($M = 14.00, SD = 3.74$) and Kopanang ($M = 13.19, SD = 4.01$) preschools $F(2, 69) = 10.43, p < .05$. The effect size of this result was medium to large ($r = .48$).

To test the differences in the cognitive skills of the children after the numeracy intervention, the Mma-lerato children were tested before and after the intervention. On two of the cognitive tests they scored significantly better after the intervention. On the non-word recall test, which tested the verbal short term memory, there was a significance difference between the two scores of the children $t(19) = -3.12, p < .05$. The effect size on this result was found to be large ($r = .60$). The mean scores of the children were higher after the intervention ($M = 9.70, SD = 2.32$) than before the intervention ($M = 11.35, SD = 1.90$), which means that they had more good answers on the test items after the intervention. The children also scored significantly better on inhibition after the intervention, which was tested by the Shape Stroop test $t(13) = 4.59, p < .05$. The effect size of this result was found to be high ($r = .79$). Before the intervention, the children had a higher score ($M = 1.23, SD = .16$) then after the intervention ($M = 1.05, SD = .10$). However, on this test the higher the score, the more mistakes that were made. The children had significant less mistakes on this test after the intervention.

Numeracy tests

The children in the three preschools did not differ significantly in their numeracy skills before the intervention. There was no significant difference found between the three preschools in the ‘numbers and shapes task’ before the intervention $t(2, 46) = .38, p > .05$. There was also no significant difference found between the three preschools in the ‘comparing quantities task’ before the intervention $t(2, 51) = .39, p > .05$. After the intervention, the children of the three preschools scored a significant improvement on the numbers and shapes task. The children of Tholulwazi had significantly less mistakes on this task after the intervention $t(8) = 2.70, p < .05$. The effect size of this result was found to be high ($r = .63$). The children of Kopanang had significant less mistakes after the intervention $t(13) = 2.99, p < .05$. The effect size of this result was found to be high ($r = .67$), and also the children of Mma-

lerato preschool had significantly less mistakes on this task after the intervention $t(20) = 6.80$, $p < .05$. The effect size of this result was also found to be high ($r = .90$). The higher the scores, the more mistakes that were made. The mean scores were lower on the second measurement, indicating that the children made less mistakes in the task after the intervention. For the mean scores and standard deviations of this results, see Table 3.

Table 3
Paired Samples, 'Numbers and Shapes task'

Preschool			Mean	N	Std. Deviation	Std. Error Mean
Tholulwazi	Pair 1	Mean Before	1.67	9	.15	.05
		Mean After	1.44	9	.17	.06
Kopanang	Pair 1	Mean Before	1.60	14	.10	.03
		Mean After	1.46	14	.17	.05
Mma-lerato	Pair 1	Mean Before	1.59	21	.15	.03
		Mean After	1.29	21	.18	.04

Teacher-child interaction observations

The observations of the teacher-child interaction were scored with the CLASS score list (Pianta, la Paro, & Hamre, 2006). The 8 items were tested on their reliability and it had a Cronbach's alpha of .94, which indicate that it is a reliable scale for testing teacher-child interaction (Field, 2005). The scores were analysed by comparing the mean scores on the different items during the seven observations. Tholulwazi preschool had, compared to Kopanang and Mma-lerato preschool, the highest mean score on every item. Especially on positivity and absence of negativity, the mean scores were high. Tholulwazi lowest scores were on feedback and language development (See table 4). Kopanang preschool had the lowest scores of the three preschools on 7 items, except on behavior regulation. The highest score of Kopanang preschool is on behavioral regulation and the lowest scores are on child-centeredness and sensitivity (See table 4). Mma-lerato scores high on positivity and absence of negativity. The lowest scores are on sensitivity, child-centeredness and feedback (See table 4).

Table 4

Descriptive Statistics, Teacher-child interaction

Preschools		N	Mean	Std. Deviation
Tholulwazi	Positivity	7	6.29	.76
	Absence of negativity	7	6.43	.54
	Sensitivity	7	5.14	1.07
	Child-centered	7	5.14	1.86
	Behavior regulation	7	5.14	1.57
	Learning and development	7	5.14	.90
	Feedback	7	4.57	1.62
	Language development	7	4.43	1.40
Kopanang	Positivity	7	3.00	1.92
	Absence of negativity	7	4.00	1.41
	Sensitivity	7	3.43	1.27
	Child-centered	7	2.71	2.29
	Behaviour regulation	7	5.00	.82
	Learning and development	7	4.14	1.46
	Feedback	7	3.71	1.38
	Language development	7	3.71	1.50
	Positivity	7	5.00	1.16
	Absence of negativity	7	5.00	1.41
	Sensitivity	7	4.00	1.29
	Child-centered	7	4.00	1.41
	Behaviour regulation	7	4.29	1.38
	Learning and development	7	4.57	1.13
	Feedback	7	4.00	1.63
	Language development	7	4.14	1.57

Figure 1, shows the mean scores during the seven observations of Tholulwazi preschool. In the graph, it is clear that Tholulwazi scores higher on teacher-child interaction in the last three observations compared to the first observations. Although some items are not stable in their mean scores, all the items had the highest scores at the last three observations. In those last three observations, the highest scores were on positivity, absence on negativity

and child-centeredness. The lowest score in these last observations was on language development, although it had made an improvement during the seven observations.

Figure 2, shows the mean scores of Kopanang preschool during the seven observations. During the intervention, Kopanang preschool had the highest mean scores on the last two observations on positivity, absent of negativity, sensitivity, child-centeredness, learning and development and language development. Behaviour regulation differs every observation in the mean score and is very high on the second and sixth observation. feedback starts with a high score, then declines and at the fifth observations it starts to improve. At the last two observations the feedback scores high again. Also in language development, the last observations has the highest mean score (See figure 2).

At Mma-lerato preschool, the mean scores on the different items are very unstable and different in every observation. The overall highest mean scores are on the items positivity and the absence on negativity. There is no stability, improvement or decline in the mean scores of the items of Mma-lerato preschool (See figure 3).

Figure 1

Mean scores on teacher-child interaction, Tholulwazi preschool

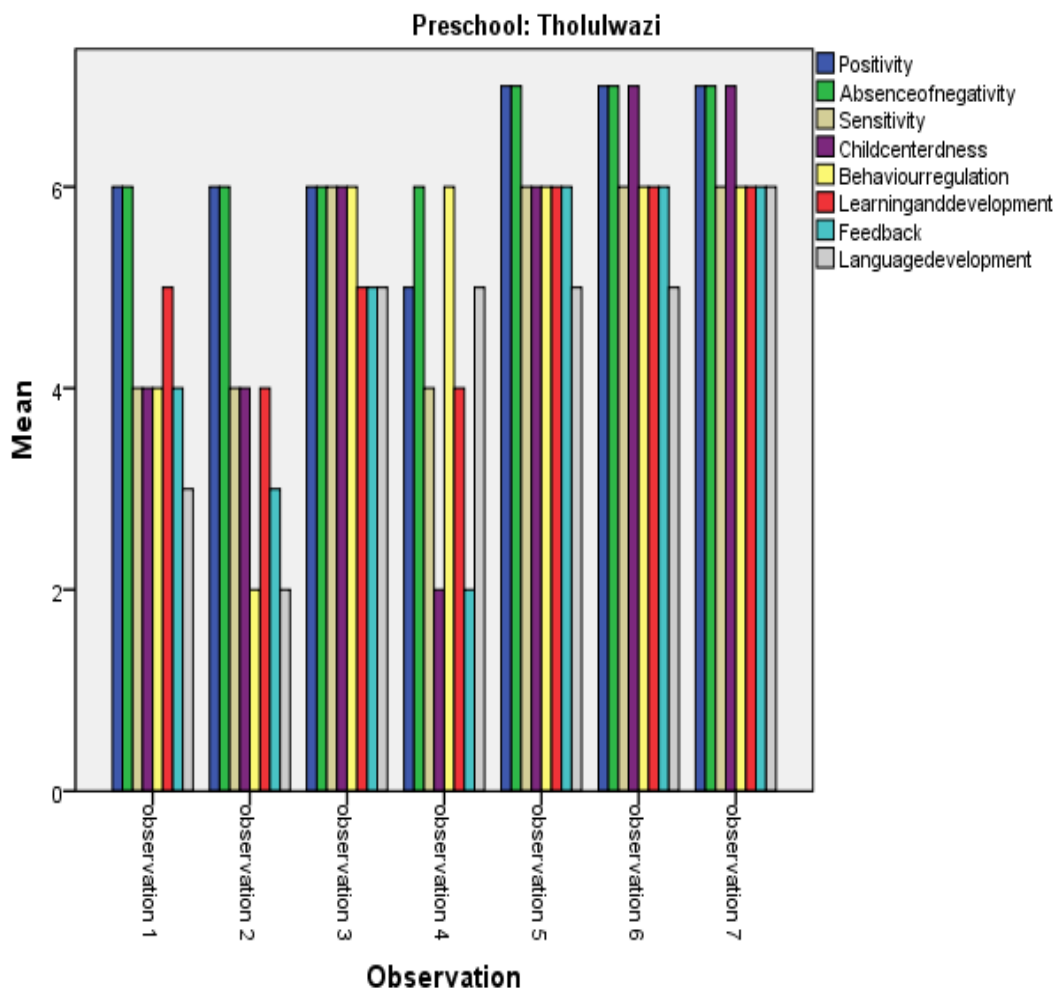


Figure 2

Mean scores on teacher-child interaction, Kopanang preschool

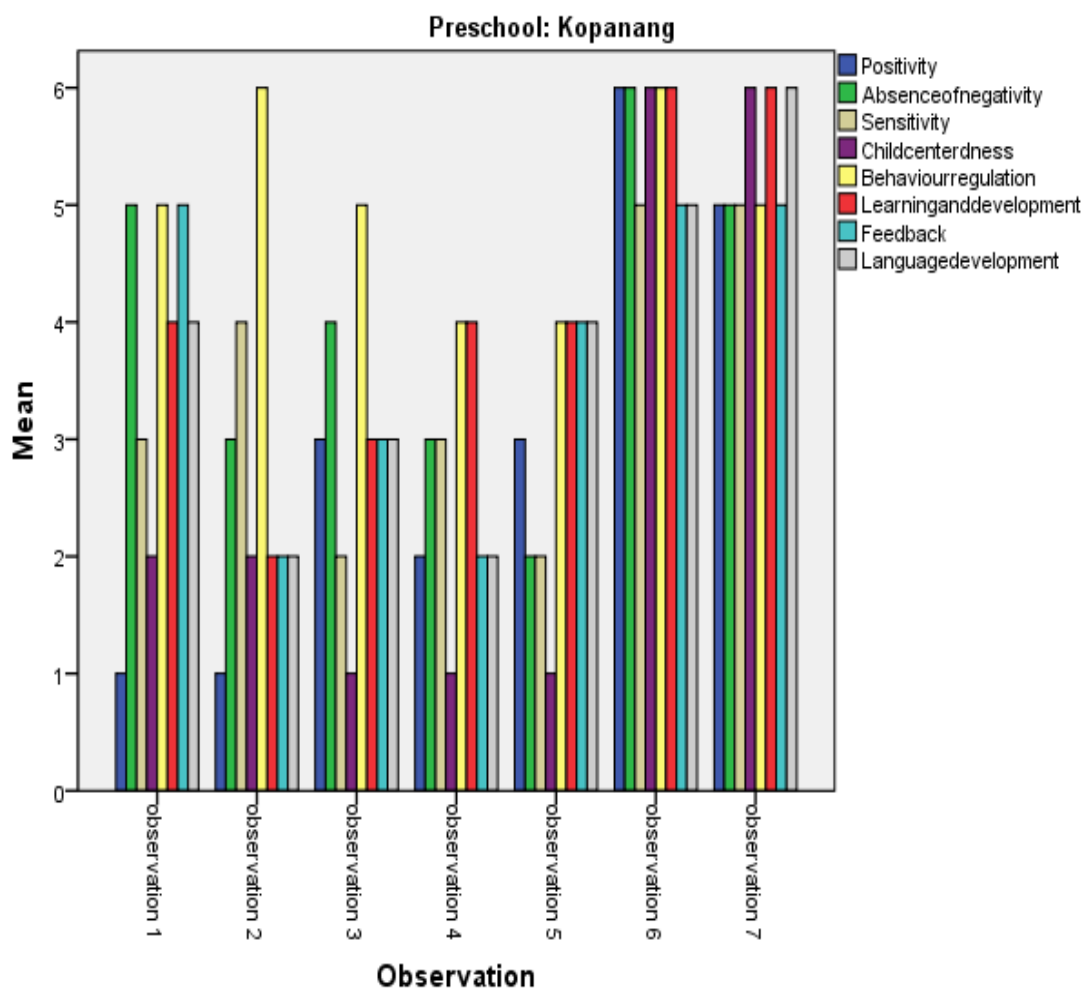
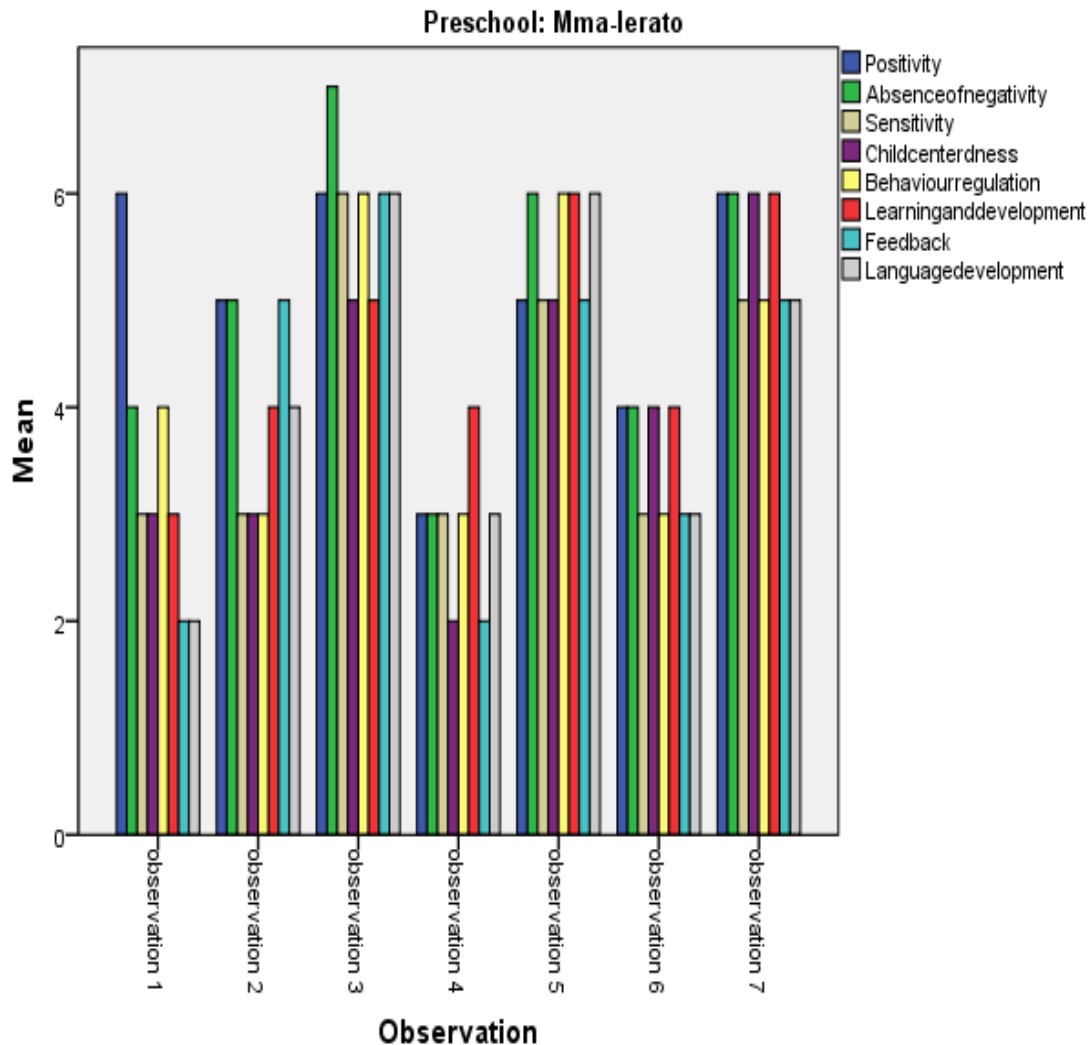


Figure 3

Mean scores on teacher-child interaction, Mma-lerato preschool



Discussion

In the present study the cognitive and numeracy skills of the children and the teacher-child interaction were measured, before and after the intervention, to observe improvements. With regard to the first aim of this study, the result was not as expected. Before the intervention, the children of the three preschools did not differ much on their cognitive skills. Mma-lerato preschool children scored significant lower on three tests, which tested the working memory (short-term memory) and English language development. However, there was no significant difference measured in the other cognitive tests. The lower scores on the working memory tests, could be explained by the fact that the Mma-lerato preschool children repeat their teachers less than the Ndlovu preschool children. During the observations, it

became clear that the children from the Ndlovu preschools, repeat their teachers a lot during the classroom activities and that the teachers were stimulating this. Repeating the teacher's words or other items, is called rote learning. In rote learning, a child is learning and repeating sound patterns and the short-term memory plays a role in doing this correctly. It is used in educational environments all around the world (Blakemore & Frith, 2006). So it can be concluded that by practicing rote learning in the classroom, the short term memory gets stimulated. At Mma-lerato preschool this rote learning did not happen often, which could have influenced the scores on the two working memory tests.

On the PVTT, which tested English language development, the three preschools differed significantly from each other. Kopanang preschool children scored significantly higher than the children on other two preschools. Tholulwazi preschool children scored significantly lower than Kopanang preschool children and significantly higher than Mma-lerato preschool children. The children of Mma-lerato preschool had a significant lower score on the PVTT compared to the Ndlovu preschool children. The results of the PVTT test, suggest that the children of Kopanang preschool know more English words than the children in the other preschools. Due to the fact that their teacher is from Swaziland, it is highly possible that this is the reason for this significance difference. During the observations, it became clear that this teacher speaks much more English with the children compared to the teachers of the other two preschools. The teacher of Mma-lerato preschool speaks less English towards the children, than the teachers of the Ndlovu preschools. According to Blakemore and Frith (2006), language development is stimulated by listening and interacting with adults. So it is highly reasonable that the teacher's use of the English language, influenced the test results. This result indicates that it is beneficial for the children, if the teachers speak more English during their preschool years. Moreover because these children have to speak English when they are going to attend primary school. Still, the differences between the three preschools on the children's cognitive skills were limited. The children did not score significantly different on attention, inhibition and on another test of working memory. An explanation for this lack of difference in cognitive skills, could be that the children were tested with different testers. Last year, the teachers tested the Ndlovu children (Van der Raadt, 2010), while in this study a Ndlovu coordinator of the nutritional units and preschools, tested the Mma-lerato preschool children. Although both, the teachers and the Ndlovu employer, were trained in testing the children (Van der Raadt, 2010), this could have influenced the results in cognitive skills. For instance, the teachers could have been less strict in testing the children, because they want the children to achieve a good score. Another explanation could be that most of the children at the

three preschools, were attending the school for only one month. Therefore, the cognitive level of the children from the different preschools could be quite similar, because they did not experience much preschool education yet.

With regard to hypothesis of the second aim, no support was found for an improvement in cognitive skills of the children from Mma-lerato preschool. After the intervention, the Mma-lerato preschool children had better achievements on two of the cognitive tests, which tested verbal short-term memory and inhibition. On the other cognitive tests, no significant difference was measured, which suggests that the intervention did not have a severe impact on the cognitive skills of the children. Though, the higher results on inhibition and verbal short-term memory, could be a result of the intervention. Positive teacher-child interaction and creative play activities have a positive influence on the development of the cognitive functions of a child (Howes & Smith, 1995). Therefore, it is possible that the intervention could have influenced these higher scores. However, since the children did not had a significantly difference on the other cognitive tests, the improvement could also be explained by the fact that the children were attending the preschools for a longer period of time in the second measurement. Preschool education is found to be beneficial for the cognitive development (Blair, 2002; Van der Raadt, 2010). Because the children were on the preschool for four months in the second measurement, this could have made them more testable and more able to control their behavior, which could have influenced the scores on verbal short term memory and inhibition. The limited improvement of the Mma-lerato preschool children on the cognitive skills, can also be caused by the limited classroom quality. The higher the classroom quality, the higher the cognitive skills of the children (Burchinal et al., 2000). The classroom of Mma-lerato has a low quality, with 43 children from different ages in one classroom and limited educational materials. It is difficult to do child-centered activities in such an environment and to have sensitive and positive teacher-child interaction (Kontos & Fiene, 1987; Phillipsen et al., 1997). The results of the teacher-child interaction at Mma-lerato preschool, during the seven observations, shows that there was no improvement. Because positive teacher-child interaction influences the cognitive development of children (Howes and Smith, 1995), this could also be the cause for the lack of improvement in the cognitive skills in these children. At last, the short period of intervention could be the cause of the limited cognitive improvement in the Mma-lerato preschool children.

As predicted in the third hypothesis, the teacher-child interaction in the Ndlovu preschools was improved during the intervention. However, the teacher-child interaction in Mma-lerato preschool did not improve. An explanation for the improvement of the interaction

in the Ndlovu preschools, is that the teachers had a teacher-meeting every two weeks. In this meeting they would receive feedback about their interaction, with the use of video observations. Other studies already showed the positive effects of this kind of teacher trainings on the teacher-child interaction (Fukkink & Tavecchio, 2010; Lyon, Gershenson, Farahmand, Thaxter, Behling, & Budd, 2009). So it is highly likely that this was of influence on the improvement of the interaction in the Ndlovu preschools. An explanation for the unstable teacher-child interaction in Mma-lerato preschool is, again, the lack of classroom quality. This made it more difficult to do child-centered activities in the classroom and to be sensitive and positive towards the children (Kontos & Fiene, 1987; Phillipson et al., 1997). Another explanation could be the motivation of the teachers. The teacher of Mma-lerato seemed less interested in the child-centered intervention than the teachers of the Ndlovu preschools. This lack of motivation and interest can also have influenced the lack of improvement in teacher-child interaction. At last, also in this result, the duration of the intervention could be of influence on the lack of improvement of the teacher-child interaction in Mma-lerato preschool. It is difficult to change the interaction skills of teachers in just four months.

The expectation of the fourth aim was correct. The numeracy skills of the children were indeed improved after the intervention. The children scored higher on knowledge of counting, numbers, measuring and geometry. Because of the numeracy intervention, including the activities and the teacher-meetings, the teachers gave more attention towards numeracy activities. The fact that these activities were more playful and child-centered, could have influenced the higher test results. According to Hirsh-Pasek and Golinkoff (2008), children in a playful, child-centered educational environment do better in tests of mathematics. The numeracy activities of the intervention, were more interesting and fun for the children. If the interest and motivation of the children to learn mathematics increases, it influences their achievements (De Corte, 1995). This finding suggest that the numeracy child-centered activities, influenced the numeracy improvement of the children. The improved positive teacher-child interaction in Tholulwazi and Kopanang preschool, could also be a cause of this improvement in numeracy skills. Prior studies showed that teacher-child interaction is important for the academic achievements of children (e.g., Howes & Smith, 1995). Moreover, Dobbs, Doctoroff, and Fisher (2003), concluded that for learning numeracy and later mathematics, a positive relationship between teacher and child improves the child's achievements. The above results indicate that it is highly reasonable that the improvement of the children's numeracy skills is caused by the child-centered numeracy intervention.

The overall aim of this study was to improve the preschool quality. The quality is, among other things, influenced by the use of educational materials (Pianta, La Paro, Payne, Cox, and Bradley, 2002), and positive teacher-child interactions (Pianta et al., 2005). The educational materials were increased in the three preschools and the teacher-child interaction was improved in the Ndlovu preschools. This, together with the improvement of numeracy skills, indicates that the preschools quality was improved because of the intervention.

Limitations and recommendations

For the interpretation of the results, there are some limitations about this study that need to be considered. First, as mentioned in the discussion, almost all the children who participated in the present study only recently started preschool education. Every January, new children are attending the preschools. So, when the children were tested for the first time, most of them attended the preschool for only one month. When they were tested for the second time, they were attending the preschool for four months, which could have influenced the results. Second, the preschool teachers could have showed social desirable behaviour during the classroom observations. They could have reacted more positively and sensitively towards the children during the time they were observed, than during the days they were not observed. This is however difficult to detect. Moreover, four months is a short period of time to change the interactional behavior of the teachers. Therefore, it would be beneficial to let the teachers participate in a long term course, where they learn about teacher-child interaction with young children. A training that could be effective for the teacher-child interaction in the preschool classrooms, is a training of the Khanya Family Centre, a NGO in South Africa. Khanya Family Centre offers a diversity of assistance programmes for employees in the work environment, to improve their performance at work. The aim of this training is to train the teachers in active listening, accurate responding, showing empathy, etc. (Khanya Family Centre, nd.). Because of the influence of the teacher-child interaction on children's academic achievements, this is something to consider. Third, it is also important to think about the teaching style in primary school. When the teaching at the primary schools is far more teacher-directive, the children are likely to experience a huge gap when they are going to attend primary school. Therefore it would be nice if the teachers of the primary schools could be involved in the teacher-child interaction trainings. At least, the teachers at the primary schools have to know the way the children were taught in the preschools, so that they could anticipate on it. Fourth, the cultural differences in the ideas and values about childcare are important to consider. These ideas in rural South Africa differ from the Western ideas of

childcare. A child-centered education is a new view in education, even in Western countries (Edwards, 2002). One must bear in mind that a child-centered education, can cause a gap between the school and the home and community environment. If the children experience a child-centered education at school and a authoritarian way of childrearing at home and in the community, this can be very confusing for them. Parental involvement in the preschool can be a way to avoid this gap. The parents will then experience what the children learn at the preschools. During parent-meetings, the teacher can explain to the parents what the benefits of playful and child-centered education are, and why it is important to do playful numeracy learning.

A general recommendation is to solve the lack of classroom quality at Mma-lerato preschool, by establishing two classrooms out of the one they have now. The children can be separated according to their age group and the teachers can do age-appropriate activities in these two groups. With two teachers and one employer who is cooking and cleaning, this is possible and it would be more peaceful and less chaotic for the teachers and the children. Because of the limited improvement in Mma-lerato preschool on the teacher-child interaction and the cognitive skills of the children, improvement of the teacher-child ratio, would be beneficial for the intervention. A second recommendation for the preschool education, is to let the teachers use the computers in their classroom more and to let the children do computer games involving numeracy. Learning to work with a computer is very important for the children, because they probably need it in their future life and work. These computers also offers numeracy learning experiences, because there are a lot of computer based numeracy games for toddlers. This is important, because children's engagement with multimedia in crèches and preschools, is an effective way to improve mathematical skills (Weiss, Kramarski, & Talis, 2006). Though, the teachers must be taught how to handle a computer. This can, for example, be explained by a Ndlovu employer who visits the preschools every week and knows how to use a computer. If these computers are going to be used, the children would have a lead compared to other children in the community, which can be very beneficial for their future career and lives.

Future research is needed to evaluate the intervention for a longer period of time and to measure the effects on cognitive and numeracy skills of the children. This would give more clear results of the influence of the intervention. Also, evaluation after the intervention is needed to see if the positive changes will last. Future research also has to focus on the literacy development of the children. For instance, a child-centered literacy play-center in the preschools, would be beneficial for the development of the children. The preschools already

have a lot of books, but they are not used very often. In a study of Dickinson and Caswell (2007), it was found that if teachers are trained in given effective literacy lessons, it is beneficial for the literacy skills of the children. Future research must also focus on the involvement of parents and the ways to improve this. The involvement of parent in their children's education, is of influence on the academic achievements of the children (Bogenschneider, 1997). Also for this child-centered intervention, it is important to involve the parents, to decline the gap between the home and school environment.

To conclude, the intervention had a duration for only four months, which is a short period of time to measure possible effects. However the effects that were measured, were positive and asks for an expansion and continuation of the intervention. The results of this study indicate that the intervention has had a positive effect on the numeracy skills of all children and on the teacher-child interaction in the Ndlovu preschools. It is recommended that the teachers will continue doing the child-centered activities and positive interaction. In this way, the children will start with a higher educational level at primary school, which leads to better academic achievements in their educational-career (Reynolds, Temple, & Ou, 2010). Ultimately, it will allow them to escape from the poor environment they live in now.

References

- Alloway, T. P., Gathercole, S. E., Kirkwood, H. J., & Elliott, J. E. (2008). Evaluating the validity of the Automated Working Memory Assessment. *Educational Psychology, 7*, 725 – 734.
- Alloway, T. P., Gathercole, S. E., & Pickering, S. J. (2004). *The automated working memory assessment*. Test battery available from authors.
- Benigno, J. P., & Ellis, S. (2004). Two is greater than three: effects of older siblings on parental support of preschoolers' counting in middle-income families. *Early Childhood Research Quarterly, 19*, 4 – 20.
- Bennet, N., Wood, L., & Rogers, S. (1997). *Teaching through play*. Buckingham: Open University Press.
- Birch, S. H., & Ladd, G. W. (1997). The teacher-child relationship and children's early school adjustment. *Journal of School Psychology, 35*, 61– 79.
- Blair, C. (2002). School readiness. Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American Psychologist, 57*, 111– 127.

- Blakemore, S. J., & Frith, U. (2006). *The learning brain. Lessons for education*. United Kingdom: Blackwell.
- Blevins-Knabe, B. (2008). *Fostering early numeracy at home*. Encyclopedia of Language and Literacy Research. Retrieved March 15, 2011 from:
<http://literacyencyclopedia.ca/index.php?fa=items.show&topicId=245>.
- Bogenschneider, K. (1997). Parent involvement in adolescent schooling: A proximal process and a transcontextual validity. *Journal of Marriage and the Family*, 59, 718 – 733.
- Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist*, 32, 513 – 531.
- Burchinal, M. R., Roberts, J. E., Riggins, R., Zeisel, S. A., Neebe, E., & Bryant, D. (2000). Quality of center based child care to early cognitive and language development longitudinally. *Child Development*, 71, 339 – 357.
- Case, R., Griffin, S., & Kelly, W. M. (2001). Socioeconomic differences in children's early cognitive development and their readiness for schooling. In S. L. Golbeck (Ed.), *Psychological perspectives on early childhood education: Reframing dilemmas in research and practice* (pp. 37–63). Mahwah, NJ: Erlbaum.
- Corte, de, E. (1995). Fostering cognitive growth: A perspective from research on mathematics learning and instruction. *Educational Psychologist*, 30, 37 – 46.
- Daley, K. E., & Lefevre, J. (1997). *The development of numeracy: A longitudinal study of counting and arithmetic*. Poster presented at the Biennial Meetings of the Society for Research in Child Development, Washington, USA.
- Dickinson, D. K., & Tabors, P. O. (2001). *Beginning literacy with language: Young children learning at home and school*. Baltimore: Paul H. Brookes.
- Dobbs, J., Doctoro, G. L., & Fisher, P. H. (2003). The "math is everywhere" preschool mathematics curriculum. *Teaching Children Mathematics*, 10, 20 – 22.
- Dowsett, C. J., Huston, A. C., Imes, A. E., & Gennetian, L. (2008). Structural and process features in three types of child care for children from high and low income families. *Early Childhood Research Quarterly*, 23, 69 – 93.
- Duckworth, A. L., & Seligman, M. E. P. (2005). Self-discipline outdoes IQ in predicting academic performance of adolescents, *Psychological Science*, 16, 939 – 944.
- Dunn, L. M., & Dunn, L. M. (1997). *Peabody Picture Vocabulary Test-Third Edition*. Circle Pines, MN: American Guidance Service.
- Edwards, C. P. (2002). Three approaches from Europe: Waldorf, Montessori, and Reggio Emilia. *Early Childhood Research and Practice*, 4, 2– 24.

- Enns, J., & Cameron, S. (1987). Selective attention in young children: The relations between visual search, filtering, and priming. *Journal of Experimental Child Psychology, 44*, 38 – 63.
- Field, A. (2005). *Discovering statistics using SPSS: 2nd edition*. London: Sage Publications.
- Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive function in preschoolers: A review using an integrative framework. *Psychological Bulletin, 134*, 31– 60.
- Geary, D. C., Bow-Thomas, C. C., Liu, F., & Siegler, R. S. (1996). Development of arithmetical competencies in Chinese and American children: Influence of age, language, and schooling. *Child Development, 67*, 2022 – 2044.
- Gotfried, A. E. (1990). Academic intrinsic motivation in young elementary school children. *Journal of Educational Psychology, 82*, 525 – 538.
- Grantham-McGregor, S., Cheung, J. B., & Cueto, S. (2007). Child development in developing countries 1: Developmental potential in the first 5 years for children in developing countries. *Lancet (North American edition), 369*, 60 – 70.
- Hamre, B. K., & Pianta, R. C. (2005). Can instructional and emotional support in the first grade classroom make a difference for children at risk of school failure? *Child Development, 76*, 949 – 967.
- Hewett, V. M. (2001). Examining the Reggio Emilia approach to early childhood education. *Early Childhood Education Journal, 29*, 95 – 100.
- Hirsh-Pasek, K., & Golinkoff, R. M. (2008). *Why play = learning. Encyclopedia on early childhood development*. USA: Temple University.
- Howes, C., Burchinal, M., Pianta, R., Bryant, D., Early, D., Clifford, R. M., Barbarin, O. (2008). Ready to learn? Children's pre-academic achievement in pre-kindergarten programs. *Early Childhood Research Quarterly, 23*, 27– 50.
- Howes, C., & Smith, E. W. (1995). Relations among child care quality, teacher behavior, children's play activities, emotional security, and cognitive activity in child care. *Early Childhood Research Quarterly, 10*, 381– 404.
- Khanya Family Centre (nd.). *Khanya Family Centre*. Retrieved May 19, 2011 from <http://www.khanyafc.org.za/index.html>.
- Koerhuis, I. (2010). Van welk kind is. Nieuwe toets Rekenen voor kleuters van Cito. *Volgens Bartjens, 30*, 4 – 7.
- Kontos, S., & Fiene, R. (1987). *Child care quality compliance with regulations, and children's development: The Pennsylvania study*. In D. Phyllips (Ed.), *Quality in child*

- care: What does research tell us? (pp.57-80). Washington, DC: National Association for the Education of Young Children.
- Laan, van der, J. (2010). *Introducing a Reggio Emilia approach to education*. Unpublished master's thesis, University of Utrecht, Utrecht.
- Ladders out of poverty (2006). Ladders out of poverty. *Economist*, 378, 9 – 10.
- Landsdown, G. (2001). *Promoting children participation in democratic decision-making*, Florence: UNICEF Innocenti Research Centre.
- La Paro, K., Pianta, R., & Stuhlman, M. (2004). Classroom Assessment Scoring System (CLASS): Findings from the pre-k year. *The Elementary School Journal*.
- Liddell, C., & Rae, G. (2001). Predicting early grade retention: A longitudinal investigation of primary school progress in a sample of rural South African children. *British Journal of Educational Psychology*, 71, 413 – 429.
- Linder, S., Powers-Costello, B., Stegelin, D. A. (1998). Mathematics in early childhood: research-based rationale and practical strategies. *Early Childhood Education Journal*, 39, 29 – 37.
- Lyon, A. R., Gershenson, R. A., Farahmand, F. K., Thaxter, P. J., Behling, S. & Budd, K. S. (2009). Effectiveness of teacher- child interaction training (TCIT) in a preschool setting. *Behavior Modification*, 33, 855 – 885.
- Malmberg, L. E., Mwaura, P., & Sylva, K. (2011) Effects of a preschool intervention on cognitive development among East-African preschool children: A flexibly time coded growth model. *Early Childhood Research Quarterly*, 26, 124 – 133.
- Meeuwig, M., Schepers, W., & Van der Werf, T. (2007). *Sporen van Reggio: Een introductie in de Sporen-Pedagogiek*. SWP: Amsterdam.
- Melhuish, E. C., Phan, M. B., Sylva, K., Sammons, P., Siraj-Blatchford, I., & Taggart, B. (2008). Effects of the home learning environment and preschool center experience upon literacy and numeracy development in early primary school. *Journal of Social Issues*, 64, 95 – 114.
- Messer, M. H., Leseman, P. P. M., Boom, J., & Mayo, A. Y. (2010). Phonotactic probability effect in non-word recall and its relationship with vocabulary in monolingual and bilingual preschoolers. *Journal of Experimental Child Psychology*, 105, 306 – 329.
- Mirsky, A. F. (1996). *Disorders of attention: A neuropsychological perspective*. In G. R. Lyon & N. A. Krasnegor (Eds.), *Attention, memory, and executive function* (pp. 71–96). Baltimore: Brooks.

- Mwaura, P., Sylva, K., & Malmberg, L. E. (2008). Evaluating the Madrasa pre-school programme in East Africa: A quasi experimental study. *International Journal of Early Years Education*, 16, 237– 255.
- Ndlovu Care Group. (nd.). *Ndlovu Care Group*. Retrieved November 26, 2010, from <http://www.ndlovucaregroup.com>.
- Peisner-Feinberg, E. S., Burchinal, M. R., Clifford, R. M., Culkin, M. L., Howes, C., & Kagan, S. L. (2001). The relation of preschool child-care quality to children's cognitive and social developmental trajectories through second grade. *Child Development*, 72, 1534 – 1553.
- Phillipsen, L., Burchinal, M., Howes, C., & Creyer, D. (1997). The prediction of process quality from structural features of child care. *Early Childhood Research Quarterly*, 12, 281– 304.
- Pianta, R., Howes, C., Burchinal, M., Bryant, D., Clifford, R., & Early, D. (2005). Features of pre-kindergarten programs, classrooms, and teachers: Do they predict observed classroom quality and child-teacher interactions? *Applied Developmental Science*, 9, 144 – 159.
- Pianta, R. C., La Paro, K. M., & Hamre, B. K. (2006). The classroom Assessment Scoring System Preschool (Pre-K) version. Manual. Center for Advanced Study of Teaching and Learning. Charlottesville, VA.
- Pianta, R. C., La Paro, K. M., Payne, C., Cox, M. J., & Bradley, R. (2002). The relation of kindergarten classroom environment to teacher, family, and school characteristics and child outcomes. *The Elementary School Journal*, 102, 225 – 238.
- Posner, M. I., & Petersen, S. (1990). The attention system of the human brain. *Annual Review of Neuroscience*, 13, 25 – 42.
- Raadt, van der, R. (2010). *Early childhood development: Preschool of no preschool?* Unpublished master's thesis, University of Utrecht, Utrecht.
- Reynolds, G. (1998). Reggio Emilia: An impossible dream? *Canadian Children*, 19, 10 – 15.
- Reynolds, A. J., Temple, J. A., & Ou, S. R. (2010). Preschool education, educational attainment, and crime prevention: Contributions of cognitive and non-cognitive skills. *Children and Youth Services Review*, 32, 1054 – 1063.
- Rimm-Kaufman, S. E., Pianta, R. C., & Cox, M. J. (2000). Teachers' judgments of problems in the transition to kindergarten. *Early Childhood Research*, 15, 147– 166.
- Sammons, P., Sylva, K., Melhuish, E., Siraj-Blatchford, I., Taggart, B., & Elliot, K. (2003). *Measuring the impact of pre-school on children's cognitive progress over the*

- preschool period* (Technical Paper 8a). London, UK: Institute of Education, University of London.
- Samuelsson, I. P., & Carlsson, M. A. (2008). The playing learning child: Towards a pedagogy of early childhood. *Scandinavian Journal of Educational research*, *52*, 623 – 642.
- Starkey, P., & Klein, A. (2000). Fostering parental support for children's mathematical development: An intervention with Head Start families. *Early Education and Development*, *11*, 659 – 680.
- Strong-Wilson, T., & Ellis, J. (2007). Children and place: Reggio Emilia's environment as third teacher. *Theory Into Practice*, *46*, 40 – 47.
- Sutherland, K. S., Lewis-Palmer, T., Stichter, J., & Morgan, P. L. (2008). Examining the influence of teacher behavior and classroom context on the behavioral and academic outcomes for students with emotional and behavioral disorders. *The Journal of Special Education*, *14*, 223 – 233.
- Sutherland, K. S., & Oswald, D. P. (2005). The relationship between teacher and student behavior in classrooms for students with emotional and behavioral disorders: Transactional processes. *Journal of Child and Family Studies*, *4*, 1 – 14.
- Sutherland, K. S., Wehby, J. H., & Copeland, S. R. (2000). Effect of varying rates of behavior-specific praise on the on-task behavior of students with EBD. *Journal of Emotional and Behavioral Disorders*, *8*, 2 – 8.
- Talbot, J. P., & Thornton, L. (2009). *A manual promoting play for children in South Africa. A Chance To Play*. Terre des Hommes.
- Tempelman, H., Slabbert, M., Gosling, A., & Vermeer, A. (2010). *A model for integrated health, child and community care in rural South Africa. Ndlovu Care Group*. VU University Press: Amsterdam.
- Tunstall, P., Gipps, C. (1996). Teacher feedback to young children in formative assessment: A typology. *British Educational Research Journal*, *22*, 389 – 405.
- Tzuo, P. W. (2007). The tension between teacher control and children's freedom in a child centered classroom: resolving the practical dilemma through a closer look at the related theories. *Early Childhood Education*, *35*, 33 – 39.
- Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

- Wasik, B. A. (2010). What teachers can do to promote preschoolers' vocabulary development: strategies from an effective language and literacy professional development coaching Model. *Reading Teacher, 63*, 621– 634.
- Weiss, I., Kramarski, B., & Talis, S. (2006). Effects of multimedia environments on kindergarten children's mathematical achievements and style of learning *Educational Media International, 43*, 3–17.
- Wigfield, A., & Eccles, J. S. (2000). Expectancy value theory of achievement motivation. *Contemporary Educational Psychology, 25*, 68 – 81.
- Wishard, A. G., Shivers, E. M., Howes, C., & Ritchie, S. (2003). Child care programs and teacher practices: Associations with quality and children's experiences. *Early Childhood Research Quarterly, 18*, 65 – 03.
- Yoon, J. S. (2002). Teacher charecterastics as predictors of teacher-student relationships: stress, negative affect, and self-efficacy. *Social Behavior and Personality, 30*, 485 – 494.
- Zelazo, P. D., Carter, A., Reznick, J. S., & Frye, D. (1997). Early development of executive function: A problem-solving framework. *Review of General Psychology, 1*, 1 – 29.