POOR MATHEMATICS PERFORMANCE OF SOUTH AFRICAN STUDENTS POINT TOWARDS POOR MATHEMATICS FOUNDATION OF YOUNG CHILDREN.

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South African students continue to perform poorly in mathematics regardless of all the efforts the country has done. Research and evaluations of mathematics education intervention point to the lack of foundational knowledge as one of the key factors for this poor performance. Hence this desktop review focused on reviewing pre-school mathematics education provision in the country and its’ research to inform debates about best practises. However, the findings of this review are not too strong because of the limited research that has been done in mathematics education of young children in the country. The findings of this review therefore call for more research in all key findings such as educator beliefs, educator knowledge, accessibility of learning materials, appropriateness of current practises and the role of multilingualism in the mathematics stimulation of young children.

INTRODUCTION

Access to quality education has been prioritized in the new democratic South Africa. Reviews of education have indicated the in-depth of inequalities in the education system that had created poor quality provision. This poor education quality provision is more observed in the previously disadvantaged groups of South Africa. These inequalities make educational changes unfulfilled objectives. The education system together with private sector invests in improving the mathematics performance of students. However, evaluations continue to indicate that the monetary value of these investments is not observed in the outputs. It is the aim of the South African policy to provide all children with quality education. Hence, many efforts have been undertaken to improve education. However, evaluations of such efforts reveal that students lack foundational knowledge. Since these findings the Presidency in 2014 has promised to commit itself in focusing in the young children’s education prior formal education by providing quality pre-schooling. However, the commitment from the President’s states of Nation address in 2014 states that “Education is the ladder out of poverty for millions of our people. We are happy therefore that there is a huge increase in the enrolment of children in school from pre-primary to tertiary level. The number of children attending Grade R has more than doubled, moving from about 300 thousand to more than 700 thousand between 2003 and 2011. A draft Policy Framework towards Universal Access to Grade R has been gazetted for public comment with a view to make Grade R compulsory.” This report indicates that the pre-primary education the President is focusing on is Grade R. The country still lags behind on education for zero to four year olds. The diagnostic review of early
childhood development (Richter et al, 2012) revealed that only 20% of zero to 4 year old children has access to early childhood centres and there is no government support for parents from poor economic backgrounds. These findings show the wide gap between quality early mathematics stimulation young children are exposed to (Feza, 2013). However, there is not enough evidence on the quality of mathematics stimulation provided by those centres.

This paper therefore, aims to review the mathematics education research of pre-schools including Grade R in South Africa. With the aim to identify pockets of excellence if there are any and to identify research gaps that the country has for it to move forward with the quality provision of mathematics education for young children. Literature on early childhood mathematics education will be consulted to frame the way forward for this field of research.

RESEARCH QUESTIONS
This paper will employ the following questions in achieving the aim of this study:

What are the principles guiding the mathematics education of pre-school children in South Africa?

1. How are the principles perceived by the practitioners’ of these young children?
2. Does the implementation align with the guiding principles?
3. How does the research shape this field in terms of practitioner development, and the child development?

LITERATURE REVIEW
Preschool exposure is already been reported to have positive influence on students’ mathematics performance (Spaull, 2011). Spaull’s findings are also supported by the report compiled by Kühne et al (2013) that argues that the performance gaps of students goes back to their early years of schooling before the reception class. Feza (2012b) highlights the need to address educator’s preparedness in providing mathematics stimulation to young children. Opinion pieces advocate for child appropriate practices to stimulate mathematics such as purposeful play, child directed activities, scaffolding, mediation that follows children’s intuition (Harris, 2012, Kühne et al, 2013, Feza, 2012a). South African White Paper 1 on Education and Training support these finding by acknowledging early childhood education as the foundational core for human development (DoE, 2001).

THEORETICAL FRAMEWORK
Two views of reason have been dominating the literature of early childhood education. These views originate from the research conducted by Piaget and Vygotsky. Many researchers have supported or challenged these views over the years. However, the practitioner's views continue to affiliate to one of the two views as reported by (Feza, 2013).
Piagetian perspective

Piaget's literature on how young children learn suggests active experience of their surroundings so that they can create their own knowledge (Feza, 2012a). Most researchers who follow this view promote discovery approach. Kamii and DeClark (1985) support this view by arguing for autonomy in children. In their description autonomy means "governed by oneself" (Feza, 2012a, 62). This description argues that educators or caregivers of young children need to nurture young children to become independent decision makers who do not depend on praises in taking correct decisions. Kamii and DeClark (1985) elaborate further by mentioning two kinds of autonomy: intellectual autonomy and moral autonomy. In this review I refer to the intellectual autonomy. When children have acquired this skill according to Kamii and DeClark they will be eager to figure out experiences that they experience and look for answers themselves.

Vigotsykian perspective

This perspective brings in an adult or skilled peer into the learning process. Vygotsky's work encourages mediation that aims to take learners to the next level of development. In his work he describes learning as an internalization of external tools that are regarded as internalised when they become internal tools (Vygotsky, 1978). Researchers affiliating to Vygotsky's perspective argue that the educator is crucial for young children's cognitive development (Feza, 2012a, Ginsburg, Lee and Boyd, 2008 and Clements and Sarama, 2009). Feza (2013,4) summarises the strategies that stimulate mathematics thinking of children as follows:

- Purposeful play
- Scaffolding children’s mathematics learning
- Extending children’s thinking through questioning
- Developing mathematics from children’s activity
- Balance between child-initiated activity and adult-initiated activity
- Balance between individual activity and group activity
- Connecting children’s informal knowledge with formal mathematics
- Have an explicit purpose of mathematics learning

Purposeful play

Bruner 1972; Cohen,2006; Copley and Oto 2006; Creasey, Jarvis, and Berk 1998; Gilbert, Harte, and Patrick,2011; Neuman and Roskos 1993; Vukelich 1994 indicate that through play young children obtain new vocabulary, attain reading skills from the play-related printed material, learn to control their behaviour by taking turns and learning to share, and also allows children to attain social skills. Drew et al (2008) suggest three principles that should guide constructive play as early as toddler years. The three principles are:
• Play should be integrated with investigation to nurture inquiry skills
• Educators should be well equipped with methods of using resources to be able to create deliberate strategies for interacting with children.
• Educator professional development should provide teachers with skills on how to create constructive play with materials

**Scaffolding children’s mathematics learning**

Vygotsky (1978) suggest that in mediating construction of knowledge scaffolding plays an important role. As researchers indicate scaffolding in young children’s learning enhances their ability to finish tasks at hand (Anghileri 2006; Lee 2011; Morrisey and Brown 2009). Feza (2013) describes scaffolding as a role played by the educator or adult expert during learning by engaging a child with a purpose of extending the child’s level of thinking. However, without understanding Vigotsky’s Zone of Proximal development (ZPD) scaffolding might not yield to the expected outcomes. Educators need to first investigate the child’s actual level of performance and then identify the child’s potential (Feza, 2012b). These two levels describe the child’s ZPD as described in (Feza, 2012b). The scaffolding has to be aimed at the child actual level so that the child’s potential can be identified. Clements and Sarama (2009) developed learning trajectories for young children that assist by providing developmental levels that assist in identify the child’s ZPD. Lee (2011) suggests that educators keep within children’s ZPD when scaffolding and according to Lee that kind of scaffolding is intentional. Brodova and Leong (2001) assert that educators should observe children’s actions during play or activity and identify what the child can do. The observation of young children’s activity requires that they use manipulatives/concrete materials.

**Manipulatives in mathematics stimulation of young children**

Young children acquire knowledge through their senses; hence physical manipulatives become an important part of their learning. In mathematics manipulatives allow young children to sort, compose, decompose and rearrange (Bruner, 1977; Dienes, 1973; Piaget, 1995; Clements, 1999; Kennedy, 1986). Rittle-Johnson and Koedinger (2005) assert that learning processes of young children are intuitive, hence their engagement with manipulatives enhance their development.

**RESEARCH DESIGN**

A desktop review of curriculum in mathematics education of young children in South Africa is conducted to establish guiding principles for such provision. Also, literature review on pre-school practitioner’s views on how young children learn mathematics inclusive of their attitudes is reviewed to understand their understanding of their role in nurturing mathematical development of young children. Furthermore literature on how pre-school attending children perform in formal schooling will be reviewed with the aim of determining the quality of mathematics stimulation offered in pre-school
education. Generally, literature on early childhood mathematics education is reviewed to understand current debate and propose recommendations for strengthening mathematics education of young children in the country. A qualitative analysis of the research articles will be conducted using thematic approach and a thematic report of findings is be reported.

**FINDINGS**

The findings indicate that the mathematics education field for young children below the age of six is still developing in the country. The limited number of research articles on this field and the journey experienced in the curriculum development indicate so.

**Curriculum Principles**

**South African National Curriculum Framework from birth to 4**

The vision of the National Curriculum Framework from birth to 4 mentions that “Working with and for all children in the early years in a respectful way to provide them with quality experiences and equality of opportunities to achieve their full potential” (Ebrahim & Irvine, 2012).

Guiding principles for mathematics:

- Children need to explore mathematics
- Educators need to provide children with opportunities to explore, learn and practice their emerging mathematical understandings

These guiding principles do not indicate the role of the educator in mediating learning; however the aims, developmental guidelines give detailed activities that mediate learning of mathematics (Ebrahim & Irvine, 2012).

**South African curriculum for Grade R**

In Grade R only guiding principles are presented because Grade R curriculum is part of the whole schooling curriculum that is too broad for this review.

Guiding principles for mathematics:

- integration and play based learning
- the teacher should be pro-active, a mediator rather than a facilitator.
- a mediator makes the most of incidental learning opportunities that arise spontaneously during a range of child-centred activities as well as teacher-guided activities that focus on mathematical concepts (CAPS, 2012)

**Educators’ perspectives on children’s readiness to learn mathematics**

Ebrahim (2010); Feza (2012b) revealed that educators of young children’s beliefs are influenced by the age of the child with a perspective that they are not ready to learn. In Ebrahim (2010) educator’s discourse indicates that children are dependent and
weak. While on the other hand most educators believe that exposing young children in mathematics is vital, few of them still believe that young children are too young to learn mathematics (Feza, 2012b). In addition Ebrahim (2010) highlights that language of learning in early childhood centres is English and thus children from homes that are not speakers of English are labelled as having language problems.

**Quality of mathematics provision and practise**

The literature reveals that one of the major challenges in the education of young children in South Africa is educator qualification (Feza, 2013; Botha et al., 2005; Atmore et al., 2012). Educators in most affluent pre-school have higher qualifications compared to those in low socio economic centres (Feza, 2013). This is supported by the educator knowledge discrepancies highlighted in Feza (2012b) that educators from affluent pre-schools demonstrate sound knowledge of number development while their colleagues from low socio economic preschool indicate gaps in their knowledge. This study also revealed that geometrical knowledge of educators has gaps across regardless of the socio-economic status of a preschool centre. Therefore, the findings assert that poor qualification influences the quality of provision given to the young children. Botha et al (2005) point out that in practise, educator talk ranks higher than illustration indicating lack of understanding on how young children engage with their world. Lack of educator understanding on how young children learn and lack of physical resources that stimulate mathematical understanding across all preschools for young children indicate the unpreparedness of the centres to provide developmental appropriate mathematical stimulation to these young children (Feza, 2013). These challenges are also observed in Grade R classes with poor basic resources and absence of learning materials for child manipulation through senses (Atmore et al, 2012).

Only one study investigated young children’s understanding of patterns and revealed that children operate at a lower level as they could not recognise patterns but regarded them as individual pictures (Hutchinson and Pournara, 2011).

**Impact of early childhood attendance to schooling**

Socio economic factors play a significant role on the impact of pre-school attendance for the South African child. Not all young children of South Africa can access preschool education due to lack of financial resources at home. Therefore these findings refer to those children that are financially able to access preschool. Moloi & Chetty (2011) in their analysis of Southern and Eastern Africa Consortium for Monitoring Education Quality (SACMEQ) study results revealed that preschool attendance has positive influence on the reading and mathematics skills shown by children in Grade 6. Gustafsson (2010) supports these findings and highlight that in rural schools the influence of preschool attendance indicates higher gains.
DISCUSSION AND CONCLUSION

This desktop review indicates six important key areas on mathematics of young children in South Africa. These key areas are:

- a curriculum that indicates that the country has confidence in its’ children’s mathematical capabilities and encourages both children guided and educator guided instruction.
- educators affiliate to different schools of beliefs with some believing that with assistance children can learn mathematics while the other school believe that children are not ready for mathematics
- the cindarella status of early childhood education is significant in South Africa characterised by poor educator qualification, poor resourced early childhood centres and poor resourced primary schools to accommodate Grade R
- the poor understanding showed by young children may also be linked with educator qualification
- preschool attendance shows educational gains for South African children.
- Home language in pre-school that is seen as a barrier than as capital or a tool for learning

The limit of these key findings is the lack of intensive research on all the five key areas that emerged from this review and therefore, they are not substantially supported in the context of South Africa. This review therefore indicates a significant need for research in mathematics education of young children in South Africa. South African emerging research supports the work of Lee and Ginsburg (2009) about educators’ misconception on children’s abilities. Also the work of Vygotsky (1978); Anghileri 2006; Lee 2011; Morrisey and Brown 2009 on mediating and scaffolding young children’s ideas is supported through the National Curriculum Framework. This review calls for more research in this field with the aim to understand the context of the South African child especially looking at the inequities and their play in implementing of intended curriculum, also the home language of children needs more research on how it can be used as their cultural capital for development rather than the current findings that it is perceived as a barrier for learning.

REFERENCES


Kühne, C., O’Carroll, S., Comrie, B., & Hackman, R. (2013). *Much more than counting: Supporting mathematics development between birth and five years.* The Schools Development Unit (UCT) and Wordworks, Cape Town.


