

Early Childhood (0-4 yrs) Practitioners' Views on How Children

Learn Mathematics

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Abstract: This paper highlights the varied understandings of practitioners of young children on how young children learn mathematics. Therefore argues for interventions that highlight mathematics curriculum for young children and bring forth the latest debate on young children's ways of learning mathematics. Literature supports this argument by highlighting children's innate mathematics abilities as early as 6 months old. These abilities begin to vary as they are nurtured or impeded by the environment the child is exposed to. Stimulation varies in an inequitable society like South Africa hence such big gaps in mathematics performance of students. Nineteen questionnaires of practitioners from pre-schools across socio economic backgrounds were analysed using excel spread sheet for frequencies and thematic approach for qualitative data. The findings reveal that most practitioners believe that young children need to be exposed early on mathematics learning. This belief is supported by a sound knowledge of mathematics knowledge for young children and challenged by lack of this knowledge. Whereas few practitioners believe that young children are not ready for mathematics. Practitioners from affluent ECD centers show sound knowledge of number compared to their counterparts from disadvantaged communities. However, knowledge of shapes challenges all groups regardless of their background. Discovery learning and mediated learning are pedagogical approaches selected by practitioners, the latter being a preference of practitioners from disadvantaged ECD centres and the first option from affluent centres.

Key words: young children, conceptual knowledge, misconceptions, beliefs, practitioners, mediated learning, discovery learning

1. Introduction

South Africa continues to lag behind in students' mathematics performance at all levels. This raises concern and demand urgent attention. Current debates about education have acknowledged the weakness of poor early childhood development in preparing for future schooling and successful adult career life. Starkey et al. (2004) supports this acknowledgement by teasing out the major areas where the gap really begins. He cautions that pre-kindergarten mathematics education quality will increase levels of school readiness for all children regardless of their economic status.

South African students are already demonstrating the outputs of having less-prepared children by performing poorly in international tests like Trends in International Mathematics and Science Study (TIMSS), The Southern and Eastern Africa Consortium for Monitoring Educational Quality SACMEQ and also in national tests. Starkey et al

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(2004) highlight pre-school quality as a significant factor in the learning of mathematics for young children. Regarding South Africa's major challenge of increasing inequities and poverty levels support the proposal for quality early childhood mathematics instruction. Hence, this paper begins with understanding early childhood practitioner's views on how young children learn mathematics to create a debate for research and teacher training of early childhood practitioners in mathematics education.

1.1 Research Questions

In achieving this study's objective early childhood practitioners' views on how young children learn mathematics and the learning opportunities these children are exposed to were investigated using the response to the following question:

What kind of knowledge and training do early childhood practitioners possess about how young children (0–4 yrs) learn mathematics, in South Africa?

2. Literature Review

2.1 South African Young Children's Development

UNICEF (2010) reported that 42% of South African children come from homes where both parents are not working. Only a lower percentage of children are enrolled in early childhood development (ECD) facilities. For example only 5% of 0 to 3 years children were enrolled in ECD facilities and 15% of 3 to 5 year olds (UNICEF, 2010). Richter et al. (2012) suggested that the reason for this low enrolment for 3–4 year olds is the availability of ECD centres in the communities and availability of fees from home to pay for the service. Research has raised concern on the quality of early mathematics preparation reflecting on the poor mathematics performance in national and international studies (Reddy, 2007; Howie, 2003; van der Berg & Louw, 2006). Confirming this concern is the study of black children from informal settlements who attended pre-schools, between the ages five and five and a half who showed low literacy skills, poor fine motor development, and poor visual analysis and synthesis (Pretorius and Naude, 2002). These results highlight the importance of quality pre-school programmes in nurturing the cognitive development of children from different socio-economic backgrounds. However, numeracy development lags behind in the South African research and practice for young children coming from communities stricken by poor resources.

2.2 How Children Learn Mathematics

There are two major theoretical cognitive perspectives that influence thought and practice in early childhood development practices. These two theories are Piagetian and Vygotskian perspectives.

2.2.1 Piagetian Perspective

Constructivism theory of Piaget suggests that young children create knowledge through active experience of the world. The active experience involves "creation, testing, refining original thoughts" and intuitive ideas about how things work (DeVries and Sales, 2011; p. 11). In Piaget's view this experience can only happen to physical knowledge Piaget (1964, 1969); because young children only connect or make links between physical objects mentally (DeVries and Sales, 2011). How these children experience this physical world is determined by them attaining autonomy (Kamii and DeClark, 1985). Kamii and DeClark describe autonomy as "being governed by oneself"(p.40). This autonomy in Kamii and DeClark's (1945) view is attained by young children only if educators create a classroom environment that will allow young children to engage with their physical world actively. They highlight two aspects of autonomy: the moral and the intellectual.

Moral Autonomy

Children have to be nurtured to become independent decision makers, responsible learners who do not need affirmation for their learning (Kamii and DeClark, 1985). Moral autonomy adheres that young children independently decide on right from wrong.

Intellectual Autonomy

Children should be stimulated in such a way that their curiosity will be triggered. Their interests will be captured because they want to figure out something from their experiences of their physical world. Kamii and DeClark (1985) suggest that children should be encouraged to challenge ideas and not accept them at face value. By doing so these researchers sees this act as a strategy in enriching young children's capabilities.

2.2.2 Vygotskian Perspective

The sociocultural theory of Vygotsky asserts that all children have potential for learning regardless of their age and background. This theory recognizes ability as well as potential in children. Hence Kozulin (2003) suggests three components that are addressed by sociocultural theory:*multiculturalism, mediation and learning potential.*

Multiculturalism

Young children have innate abilities that Hyde and Spelke (2010) indicated as developing as early as 6 months old. Young children experiences add more to this development. These experiences are not the same for all children but vary in each home, culture and socio economic environment. The Vygotskian's perspective acknowledges this diversity of experiences and the diverse initial development young children acquire from their different backgrounds hence it brings forth the notion of psychological tools (Kozulin, 2003). Psychological tools are described by Kozulin as symbolic artifacts that patent from all cultures. Young children internalize these symbolic artifacts from their cultures and they become their psychological tools they use in making sense of new experiences. For example, at home children are exposed to literacy through observations, listening to adults, siblings and family at large. Kozulin (2003) states that this literacy developed from the home environment become their tool that contributes to their psychological function of their viewpoint. Starkey and Klein (2007) in their comparison study of the sociocultural influence of the United States (US) children in their mathematical development with the Chinese and Japanese children revealed that Chinese and Japanese children enter preschool with enhanced mathematical performance than the US children. This superior performance is influenced by the home environment the Chinese and Japanese children are exposed to (Starkey and Klein, 2007). The in-depth of this analysis revealed that Chinese and Japanese home literacy develop number sense better than English home literacy, supporting White (1987) findings that Asian mothers teach their children to count to high numbers.

Mediation

Mediation is an important aspect in Vygotskian theory because it is a tool for cognitive change (Donato and Maccormick, 1994). There are many forms of mediation as Donato and Maccormick assert: using the textbook, manipulatives, classroom discourse, interaction with peers, and direct instruction from the teacher.

Learning Potential

Learning potential is the prospective ability all children have (Vygotsky, 1978). Hence Vygotsky proposes that mediation plays an important role in realizing this potential whether it is through skilled peers, skilled adults, books or manipulatives. Chaiklin (2003) describe the actual performance as the zone of proximal development (ZPD). ZPD assist educators by informing them of the emerging psychological function of the child at a particular

moment that is not fully established; informing about the aided performance that could be used as an authentic parameter of assessment procedure; and how to abstract the difference between the child's ZPD and learning potential (Vygotsky, 1978; Kozulin, 2003). What the child is capable to do with support of peers, teachers, manipulatives determines what the child will be able to do without the support (Chaiklin, 2003).

3. Design

In responding to the question of the study eighteen practitioners from ECD centres across different socio-economic background of Durban in KwaZulu-Natal filled in a questionnaire on how young children learn mathematics regardless of their ECD qualification. The practitioners were given the questionnaire translated in their mother tongue. The data was analysed quantitatively using frequencies and qualitatively for in-depth description of practitioner's views and practices on how young children learn mathematics. It is important to note that only Zulu speaking practitioners were happy to use Zulu in completing the forms. Afrikaans speaking practitioners used English although there were Afrikaans questionnaire as some did not want to come out and use their Afrikaans decided not to complete it. Those who completed the forms needed assistance on making sense of some questions. This is an interesting observation on the changed status of Afrikaans in the country, although it is one of the 11 official languages.

4. Findings

In responding to the study's question the biographical information of the participants is presented and the findings revealed practitioner's beliefs on learning of mathematics concepts by young children, practitioners' understanding of the mathematics content for young children, practitioners' understanding of assessment in young children's learning of mathematics and practitioners' views on how children learn mathematics.

4.1 Biographical Information

Table 1 below indicates similarities between ECD practitioners that have not been highlighted before in the South African context. Those similarities are age ranges that starts from 20 years to 59 years on both affluent and disadvantaged centres; qualification discrepancies amongst practitioners in each socio economic group such as, not all practitioners have ECD qualifications. The differences in aforementioned groups are experience ranges; qualification range levels; and high school completion. The experience range for disadvantaged ECD centres ranges from 1 to 15 years supporting literature on access that emerged mostly post 1994, while for affluent ECD centres experience ranges from 5 to 34 years, beyond the democratic years. Qualification ranges from grade 12 to a Bachelor degree in affluent ECD centres, while it ranges from grade 10 to a Diploma in the disadvantaged centres. Also all ECD practitioners from affluent centres have completed grade 12 while as indicated in the grade ranges that some practitioners in the disadvantaged ECD centres did not complete grade 12. The gender of ECD practitioners is still dominated by females. Generally the table reveals that ECD sector is an employing sector for all working ages, the informality of ECD practices goes across different socio economic backgrounds hence there are varied qualifications, there is evident growth of ECD practitioners in disadvantaged communities.

4.2 Practitioners' Beliefs

The findings indicate a common agreement on the need to expose children as early as two to counting activities and games but vary in exposing them to shapes. All 19 practitioners agree that it is important to expose

young children to counting and emphasise four important reasons for supporting counting in early years. Out of the 19 practitioners eight (1) sees counting as part of cognitive development, five (2) sees counting as foundational for preparing young children for future learning, three (3)sees counting as a skill for everyday life and the last three (4) sees counting as a tool to emphasize play as an approach to learning for young children. These views cannot be related to different backgrounds and qualification of practitioners they go across different socio economic backgrounds, qualifications and experience. Therefore, the variability is amongst all practitioners regardless of their background. In exposing children to shapes of the 19 practitioners 14 agree to expose young children to shapes. Of the 14 practitioners 12 agrees because it is important for young children to know shapes the other 2 agrees with caution that the child's level is considered in introducing shapes and 1 practitioner for the disagreeing group supports the notion of assessing the child's level first. While the other 4 disagrees because the activity is not age appropriate for young children.

Gender	Age	Nature of	Registration	Highest	ECD	Other Qualification	Experience in
	Group	pre-school	Status	Grade	Qualification		ECD in years
F	20-29	Disad	Yes	12	none	none	1
F	20-29	Affl	Yes	12	Bachelor of	none	5
					Education (ECD)		
F	29-39	Disad	Yes	11	none	none	missing
F	29-39	Disad	No	10	none	ABET level 4 /NQF level	6
						one	
F	29-39	Disad	Yes	12	Level 6	Teacher Aide Diploma	10
F	29-39	Disad	Yes	12	Level 4	none	missing
F	29-39	Disad	Yes	12	Level 3	none	missing
F	29-39	Disad	Yes	12	none	Diploma in Educare	10
F	39-49	Disad	Yes	11	Level 3		15
F	39-49	Disad	Yes	11	Level 5	ECD	10
F	39-49	Disad	Yes	12	Level 2	Educare/conflict	6
						management	
F	39-49	Disad	No	11	Level 4		6
F	39-49	Disad	Yes	11	Level 4	Care giving (Home based)	6
						Certificate	
F	39-49	Affl	Yes	12	Certificate of	Studying	20
					foundation phase		
F	39-49	Affl	Yes	12	Level 3	Residential childcare	20
						Diploma, Access course in	
						school readiness	
F	49-59	Disad	Yes	12	none	none	5
F	49-59	Disad	Yes	10	Level 4	First Aid	7
F	49-59	Affl	Yes	12	Level 4	none	34
F	49-59	Affl	Yes	12	none	none	22

Table 1 Practitioner's Biographical Information

4.3 Practitioners' Understanding of Mathematics Content

Practitioners' understanding of the content varies amongst ECD trained and amongst those that did not receive ECD training.

Counting

Out of the 19 practitioners, seven define counting as ability to respond to the question "How many?" This response favours practitioners that have ECD qualifications across ECD centres. Whereas six practitioners define counting as verbal counting or rote counting. This response indicates lack of understanding the concept of counting and favours practitioners with no ECD qualification. The last six practitioners define counting as the

ability to count after an adult and this response does not favour having or lack of ECD qualification but goes across practitioners from disadvantaged ECD centres. Again their response indicates lack of understanding of the concept of counting.

Only one out of all 19 practitioners was able to draw the developmental path for counting. She wrote "rote counting, one to one correspondence, and counting out are basic maths skills which lay the foundation for more advance maths concepts"

Shapes

Although there were reservations amongst practitioners about introducing shapes to young children, there is a consensus amongst all 19 that young children should always here correct mathematical names of shapes when playing with them for their mathematical development and gaining more mathematical vocabulary. One of them stated that "Children learn from physical appearance using all their senses and begin to notice patterns with time". One practitioner indicated that children should be left to discover through play

The practitioners from this school of thought believe in free play and let children be children. These practitioners are predominantly from White ECD centers and use the following phrases in describing how children learn:

"At the 3 year old level children are given shapes to play with freely-to make their own patterns or to build with them even use as food or money in fantasy play, our 4 year olds know the names of the four basic shapes "children should be left to play with toys and make connections on their own and make their own puzzles; they should not be frustrated with mathematical terms."

5. Discussion

The findings reveal that practitioners believe that young children need to be exposed early on mathematics learning. However, four practitioners believe that geometrical concepts are not age appropriate for young children. Therefore, 15 practitioners disagrees with the misconception that young children cannot learn mathematics indicated by US ECD teachers in the study by Lee and Ginsburg (2009). While four practitioners support the findings of Lee and Ginsburg about the misconception that young children cannot learn mathematics. Those practitioners who believe that young children can learn mathematics are able to support their beliefs only if they have a good understanding of the knowledge relevant to young children. Practitioners from affluent ECD centers show sound relevant knowledge of number development compared to their counterparts from disadvantaged communities. While, knowledge of shapes challenges all groups regardless of their background. This finding challenges the different ECD qualification providers because if seven out of thirteen practitioners with qualifications have sound knowledge of number development what kind of training did other six received?

Discovery learning and mediated learning are approaches selected by practitioners, the latter being a preference of practitioners from disadvantaged ECD centres and the first option for affluent centres. These two schools are influenced by the Vygotskian view of mediation and the Piagetian view of waiting for children to grow older but allow them to play independently. The latter view has been challenged by literature on early childhood development looking at the psychological research on cognitive development that proves that young children learn as early and six months old (Hyde and Spelke, 2009). Some of the practitioners' views are common to the misconceptions that were indicated by Lee and Ginsburg (2009). For example the view of age inappropriate activities some practitioners have; the emphasise on letting children play on their own without pressure of learning,

and not stressing young children with mathematics vocabulary.

6. Conclusion

These findings indicate varied understanding of how children learn mathematics. Some of the understandings need to be re-visited looking at the abilities and achievements young children have shown at early ages (Starkey et al, 2007). This paper therefore argues for interventions that develop practitioners' conceptual understanding and mediation strategies that are developmental appropriate using differentiated mediation in attending diversity of the learners in their centres. South African children need to be nurtured and developed holistically for them to participate efficiently in their democratic society. Otherwise all the efforts of liberation are in vain. Piagetian theory worked for a certain percentage of children but was challenged and proven not to work for all (Hiebert, 1981). Therefore, clinging on to such theory deprives young children opportunities to reach their potential. Interventions need to bring forth discussion about these ancestral theories to the latest work that supports mediated structured mathematical play.

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