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MATHEMATICS BARRIERS EXPERIENCED BY GRADE 3 CHILDREN IN SOME PREVIOUSLY DISADVANTAGED OF SCHOOL SOUTH AFRICA

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ABSTRACT

Children as early as Foundation Phase are unable to solve mathematical problems. The problem of poor Foundation Phase learner performance in mathematics is of international concern. One of the critical concerns noted by Annual National Assessment (ANA) is the concern about the understanding of teaching mathematics content in Foundation Phase. The aim of the paper is to examine the barriers experienced by Grade 3 children in mathematics computation in previously disadvantaged schools in South Africa. The study employed a qualitative study approach-using semi – structured interviews with three teachers in three schools. All the teachers consented to participate. The main findings of this study suggest that all the barriers to learning relate to poor mathematical language proficiency. Therefore, based on the findings, the methods of teaching mathematics should change, by including for example concrete objects. Furthermore, the training of mathematics teaching should be adapted so that it should be in line with the practical teaching in class.

Keywords: primary school, learner, mathematics barriers, Grade 3, mathematics computations

INTRODUCTION

There has been a growing recognition of the importance of the early years for the acquisition of mathematical skills in South Africa. This is evidenced by the report of the former Minister of Education, Naledi Pandor. She stated that only 35% of children in South Africa could read, write and count (The Star, November 2008). This is surely not a problem in South Africa only. The realisation that a strong foundation is needed if children are to be successful in learning mathematics at higher grades prompted the Department of Basic Education (DBE) to conduct systematic evaluations in mathematic competency at primary schools. Although the poor outcome of the Annual Mathematics Assessment (DBE 2012) is symptomatic of unsatisfactory performance levels in the Foundation Phase, research at this level remains scant and indicates good mathematical skills later in school in numerous studies (Department of Basic Education, January 4 2012).

This research emanates from the recognition of problems in the teaching and learning of mathematics in Grade 3 classes of some schools in the disadvantaged areas of South Africa. The particular problem noted, is the children's inability to perform basic operations in mathematics. They lack the ability to perform computations such as addition, subtraction, multiplication and division. The concern is that, if the problems are not addressed in the Foundation Phase it might be too late to deal with them in the higher school grades.

According to the Global Competitiveness Survey of the World Economic Forum, out of 131 surveyed countries, South Africa was ranked 128 for the quality of its mathematics and science education (Pottinger 2008). Between 1998 and 2005, education in South Africa improved quantitatively but not qualitatively in comparison with other developing countries

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(Pottinger 2008). As from 1998, the number of children in South African schools has increased but not the output as indicated by the Grade 12 results. If children experience challenges in mathematics in the Foundation Phase, they might experience serious problems in later grades.

The trends in the International Mathematics and Science study in 2003 showed that South Africa was at the bottom of the pile of 46 participating countries. It was even lower than Ghana, Saudi Arabia and Botswana to mention but a few (Pottinger 2008). According to Reddy (2003), South African children achieved significantly poorer results in mathematics than all other participating countries, including Morocco and Tunisia, and would be on average older than all other children.

Numerous studies in teaching mathematics (Fricke, Horak, & Meyer 2008; Le Roux 2008; Themane, Monyeki, Nthangeni, Kemper & Twisk 2003) have been conducted in South Africa but the focus has mainly been on secondary schools. Often the investigations concentrated on classroom variables such as teaching resources and textbooks that could influence performance but not on teacher attributes that could influence negatively on successful learning. The contention is that the cumulative effect of this oversight can compound into serious mathematics learning problems at higher grades and needs to be addressed early in the child's schooling. It is also important to pay attention to specific difficulties experienced in teaching or learning mathematics in order to propose effective solutions to the problems.

THEORETICAL FRAMEWORK (LITERATURE REVIEW)

This research is framed within constructivist theory because the aim is to understand which barriers children experience when learning mathematics. This also implies that the child should be able to explain what he has learnt or to be able to practically apply the knowledge gained. For instance, the child should be able to use the knowledge gained in a lesson on addition to count the number of marbles he has.

According to Henning, van Rensburg and Smith (2005) a theoretical framework is a lens on which the researcher positions his or her study. It helps with the formulation of assumptions about the study and how it connects with the world. It is like a lens through which a researcher views the world and orients his or her study. It reflects the stance adopted by the researcher and thus frames the work, anchoring and facilitating dialogue between the literature and research.

The problem of poor mathematics performance is not only experienced in South Africa, it is universal (Reddy 2003). In an attempt to address this problem in Australia, Van Kraayenoord and Elkins (1998) and Brown, Askew, Baker, Denvir and Millet (1998) identified certain factors that contribute to poor mathematics performance, namely: teaching method (whole class teaching); failure to use knowledge associated with mathematics; language; lack of flexibility; beliefs; and quality of educator–child interaction.

Schunk (2004) asserts that the content area of mathematics is a fertile area for cognitive and constructivist research. Schunk (2004) adds that topics that have been explored include how children construct mathematical knowledge, how experts and novices differ and which methods are most effective. Schunk (2004) also charges that children and adults often construct procedures to solve numerical/mathematical problems together; however, the errors are not random but rather, systematic mistakes. Systematic mistakes reflect the constructivist assumptions that children form procedures based on their interpretation of experiences.
For example, a common mistake in subtraction is to subtract the smaller number from the bigger number in each column, regardless of direction, as follows:

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Systematic mistakes develop when the children encounter new problems and incorrectly generalise productions, especially when they do not know what to do. They modify the rules to fit the new problem (Schunk, 2004). Brown and Burton (1978) also leave a gap on how teachers teach mathematics.

A qualitative case study design conducted by (Cilliers-Du Plooy, Davis and Bezuidenhout 2014).) cites that many Grade 1 children enter South African schools with various academic and learning difficulties that might occur as a result of limited language proficiency. A child with limited language proficiency may continue to learn and understand at a slower rate. This explains why Grade 3 children who receive tuition through a language other than their own find may it difficult to understand numerical concepts, because they also struggle to master the medium of instruction itself because language and thought are interwoven. Limited language proficiency leads to learning difficulties. A child has to be competent in expressive and receptive languages in order to understand and carry out academic tasks including mathematics (Naude, Pretorius and Vandeya2002).

Children should also be able to commit what they learn to memory and be able to reproduce it when needed. It is understood that lack of language proficiency would be an impediment for children at Foundation Phase. Thus, teachers need to be patient in teaching concepts such as subtraction, division, etcetera. Mercer, (2006) argues that the tendency of mathematics educators and policy makers to emphasise the distinction between the subject language of mathematics and talk that is more informal can hinder the process of inducting children into mathematics practices.

Mercer (2006) argues that group activities offer valuable opportunities for children to construct solutions for themselves through talk, which would not be found in whole class teaching. This method encourages children to participate actively in finding solutions to problems while at the same time using language to communicate. In so doing, children are able to understand better and view mathematics exercises as everyday problems rather than something only related to the school environment and a special language — mathematics jargon. For example, during an in-depth interview, Teacher A (TA) indicated that:

> TA said: mathematics in Grade 3 is not much of a challenge, but the problem is the numerical concepts. TA further said: language is the main problem, as children need to understand concepts in English. We are supposed to teach the children in their mother tongue. There is difference in mother tongue and home language, now you have to teach children in their mother tongue, the children have different home languages and the concepts are written in English. TA further indicated the challenges they are faced with as teachers as being how they deal with the concepts not the content. It is not easy to translate the concept to the level that the children would understand. The syllabus is there, the plans are there, how I teach for example measurement, there are many aspects e.g. capacity, tessellation.

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Since language is an important factor in the learning of mathematics, it is important for children to possess this skill too. The understanding of both the spoken and written words is made difficult by the complicated and ever changing interactions among phonological processing, syntax structure and semantic variation inherent in the words used to convey meaning" (Morin & Franks 2010). Whitin and Whitin (2006) and Marr (2000) argue that teachers who believe that language is an important learning tool that helps children to communicate numerically and construct their own understanding of numerical concepts, use group work and pair investigation in the classroom. They further allege that the report back sessions provide children with the chance to discuss their tasks and their involvement in them. These feedback sessions also give children the opportunity for practical involvement and thus a chance to gain confidence. For example, during an in-depth interview, Teacher E argued that language poses challenges among the children. Usually the books are written in English and the DoE expect Grade 3 teachers to teach children using the Language of Learning and Teaching (LoLT) of the school (N.Sotho) and this poses a challenge to teachers as they do not know some concepts in N.Sotho for example "pyramid", they end up using the term in English. TE further said language poses challenges in the teaching of mathematics as most of the children are unable to read and reading is a big problem in the schools. If children can get the sounds correctly, later words and sentences, their level of understanding would be enhanced There are children who are from different ethnic groups, among others: Tsonga, Zulu, Swazi, whereas the school is predominantly N.Sotho speaking. TE indicated that, as children are unable to read, teachers read for the children so that children can understand what is expected of them.

The researcher agrees with Mercer that it is important for teachers to have knowledge of various ways in which language is used because of the important role language plays in early learning experiences. Teachers need to understand the differences between what is said and what is meant in order to use language effectively in teaching. In other words, the use of language should be kept very simple. The problem lies in the fact that many children, especially those from poor backgrounds, like those discussed in this study, come to school with little knowledge of the language of learning- English. Consequently, these children may experience learning disabilities (LDs) or specific language impairments (SLIs) which often lead to difficulty in performing mathematical tasks (Morin & Franks 2010).

Children coming to school for the first time and coming from disadvantaged communities lack preschool education. Thus, they have serious language problems and this negatively affects their learning of mathematics. To make the situation worse, some come into contact with the language of teaching for first time at school. If this problem is not attended to earlier, such children could experience learning difficulties throughout their lives.

Pal (2009) maintains that disadvantaged children (who come from poor environments and economic backgrounds) are more likely to perform poorly at school because of their "different home environments and the practices of school mathematics that do not align with knowledge, skills and dispositions that these (children) may bring to schools". Pal (2009) further alleges that children, who stem from disadvantaged groups such as those from poor urban settlements, are more at risk of finding learning mathematics as being a complex process because of their varied socio-cultural experiences and lack of "out-of-school" educational support. Therefore, lack of pre-school experience and language training places these children in an untenable situation in their education right from the beginning.

Vygotsky (1978) stresses the significance of language as a psychological and cultural tool (Mercer, 2006). He further argues that the social involvement in problem-solving activities constituted an important factor for individual development (Mercer, 2006). He charges that

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intermental (social) activity, mediated through language, can promote intramental (individual) intellectual development. By using language and examples with which the child can associate and those that stem from his immediate environments would engender a better understanding and enable the child to relate the process in his own words. The children's capacity will also be stimulated.

There are two ways of interaction through which the spoken language can be related to the learning of mathematics in schools. The first is teacher-led interaction with children – the teacher guides the children in their development and understanding, which can be important in the children' induction into discourses, associated with the particular knowledge domains. This is the concept of dialogue teaching propounded by Alexander (2000). "It concerns more subtle aspects of interaction such as, the extent to which teachers elicit children's own ideas about the work they are engaged in, make clear to them to discuss errors and misunderstandings and engage them in extended sequences of dialogue about such matters" (Mercer, 2006). "Dialogic" strategies, according to Mercer (2006), achieved better learning outcomes.

Alexander (2004) suggests that dialogic teaching is a method that employs the power of talk to encourage, expand the children' thoughts, and advance their learning and understanding. It involves both the teacher and the children, and relates to teaching across the curriculum. This approach is grounded in the principles of collectivity, reciprocity, cognition and observation. Dialogical teaching, therefore, requires children to be actively engaged in doing as well as talking (discussing/explaining) what the lesson is about. This approach as such, is good in the teaching of mathematics where children have to handle concrete objects and explain what they see and in tandem also learn the concepts. Dialogic teaching is characterised by certain features of classroom interaction, such as:

i. questions are structured so as to provoke thoughtful answers.
ii. answers provoke further questions and are seen as the building blocks of dialogue rather than its terminal point.
iii. Individual teacher–child and child–child exchanges are chained into coherent lines of enquiry rather than left stranded and disconnected. In this manner, the children experience the learning process as cooperative activity.

The second context of interaction in which spoken language can be related to the learning of mathematics in schools is that of peer group interaction. By working in pairs or groups, children become involved in interactions that are more "symmetrical" than those of teacher–pupil discourse and have different kinds of opportunities for developing reasoned arguments and describing events (Mercer, 2006). The child does not only learn mathematics, but also social interaction.

Teachers can help children to gain relevant knowledge of numerical procedures, terms, concepts and operations. They can also help children to learn how to use language to work effectively and to jointly enquire, reason, consider information, share and negotiate ideas and to make joint decisions. This kind of guidance is not usually offered (Mercer, 2006).

According to Vaidya (2008), some children suffer from dyscalculia. This is characterised by a poor understanding of the number concept and the number system characteristic of their age group. Such children experience difficulties counting, learning abstract concepts of time, direction learning, and recalling facts, sequence of past and future events, and giving and receiving change. They also fail to use rules and procedures to build on known facts. For instance, they may know that 3+5=8, but would fail to deduce that 5+3=8. Such children are generally said to have difficulties in mathematics learning. Without identification and remediation, these children would not be able to be numerically functional.

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Mathematics is a "second language" and should be taught as such. It constitutes formal learning of concepts that have hitherto not been frequently used and known to many of the children. Thus, they would also seem to be learning a different language to the one they use at home. The conceptual aspects of mathematics learning are connected to the language. It is exclusively bound to the symbolic representation of ideas. Most of the difficulties seen in mathematics, result from underdevelopment of the language of mathematics (Sharma, 1989).

The teaching of the linguistic elements of mathematics language is sorely neglected. The syntax, terminology, and the translation from English to mathematics language, and from mathematics language to English must be directly and deliberately taught. Consequently, mathematics language can pose challenges for children. For teachers to get through to their children, they should have an understanding of the "mathematics language". An added problem is that certain mathematics terms such as "hypotenuse" are not found in everyday conversations.

LANGUAGE CHALLENGES

The analysis of the data from the lesson observations, in-depth interviews and focus group discussions revealed that children with limited language proficiency may continue to learn and understand at a slower rate. Some mathematical concepts which may or may not be present in the Language of Learning and Teaching (LoLT) of the school pose a challenge to the teachers and children as the language lacks vocabulary to express the mathematical concepts. For example, during an in-depth interview, Teacher C mentioned in detail about this challenge:

> TC said children are unable to understand the concept of time, shapes, multiplication tables and are unable to count backward and forward due to language barrier. TC also mentioned that the authors also use a language that creates difficulties to the children. The LoLT of the school is N.Sotho and many children who are admitted to the school are Zulu and Tsonga. In "township language" for an example, when teaching money, children will talk of "two bob" (meaning twenty cents) and some are from other African countries. As they are expected to teach in the child's mother tongue, this becomes a barrier on her side as a teacher. TC further indicated that it is a challenge for her as the books are written in English and she should translate that to N Sotho which becomes more problematic in reading numbers in N.Sotho for example: "tee", "pedi", "tharo" instead of: one, two, three in English particularly to those children who are not N Sotho speakers. TC also said: children who did not attend preschool find it difficult to cope. TC also mentioned that language also contributes to children's problems as they speak different languages.

RESEARCH METHODOLOGY

In order to explore how mathematical games as tool for mathematics teaching can be used in the foundation phase a qualitative case study design was conducted (Cilliers-Du Plooy, Davis and Bezuidenhout 2014). The qualitative approach was most relevant in that it allowed the researcher to understand the practical experience of participants, as well as deduce how meanings are formed from the perspective of cultural differences and how they address the problems of computation (Cilliers-Du Plooy et al 2014).

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Data Collection

Data were collected using semi-structured interview. In the context of this study, the semi-structured interview was considered appropriate as it allowed the interviewer to rephrase and repeat questions to help participants how mathematical games as tool for mathematics teaching can be used in the foundation phase. Three teachers from different previously disadvantaged schools were interviewed and observed while conducting lessons in class. The semi-structured interviews were conducted with the permission of the participant, the school principal and governing body. This took place during school hours and lasted approximately 30 minutes. The semi-structured interviews were conducted in a face-to-face setting with each individual participant (McMillan and Schumacher 2016).

Sampling

A purposive sampling was used to select the participants. All teachers were targeted, with the knowledge that the group does not represent the wider population but a particular group with the same interest (Henning, Van Rensberg and Smith (2004)). For this study, the researcher-interviewed **teachers** in semi-structured interviews with open-ended questions to create opportunities for further probing (McMillan, and Schumacher (2016).

Data Analysis

The qualitative data in this study comprised the transcribed responses obtained during face-to-face interviews with teachers. Teachers already documented the structured interview responses when I talked to them. I analysed these responses electronically and identified themes and topics. I grouped themes that emerged from the interviews under broad categories based on the theoretical framework, specifically the quality indicators, namely the input, process and outcome indicators.

I organised and coded the inscriptions in broad categories to produce a record of the things that I have noticed. During the process of data analysis, I initially ended up with a huge number of themes and encountered a challenge to distinguish between possible and suitable themes for data interpretation and to strike a balance between rigour and flexibility concerning the identification of suitable themes that emerged from the interviews.

DISCUSSION OF RESULTS

This study presented barriers experienced by Grade 3 children in mathematics computation. It is clear, from the foregoing discussions, that children who do not do well in mathematics in the lower grades develop negative attitude towards mathematics and the attitude contributes to their progress in mathematical language proficiency. Subsequently, they often develop negative attitude towards mathematics learning, the mathematical language proficiency and ultimately feel insecure about their capabilities to succeed in mathematics. Mathematics barriers often arise and children fail to make headway in mathematical language proficiency, which has its own symbolic representations, syntax, and terminology. Solving word problem requires the ability to translate the mathematics language. Children with learning disabilities often have difficulty learning the skills and performing the tasks associated with mathematics, especially beyond the third grade. The main findings revealed that children were unable to perform well in mathematics computation due to language challenges.

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CONCLUSION

Considered overall, the objectives and findings of this article clearly suggested that the methods of teaching mathematics should be change by including for example cooperative learning, the use concrete objects, songs and games. . Furthermore, the training of mathematics teaching should be adapted so that it should be in line with the practical teaching in class.

Furthermore, the advantages of the use of multiple mathematics teaching approaches the learning will be simplified and made more interesting through cooperative learning and active participation.

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