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Teaching Mathematics in Grade 3

Maphetla M. Machaba

Department of Early Childhood Development, University of South Africa (UNISA), P.O. Box 392, Pretoria 0003, South Africa
E-mail: machabmm@unisa.ac.za

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ABSTRACT In South Africa, as in the rest of the world, poor learner performance in Mathematics has been a cause of concern. Learner performance in mathematical computations such as division, subtraction, multiplication and addition were a barrier to mathematical learning in many studies done. If the mathematical computational challenges do not address this problem in Foundation Phase, it might be too late to deal with them in the later years of study. Against this background, this qualitative case study explores the instructional approaches used by Grade 3 teachers in selected primary schools to teach mathematical computations. Data were collected using semi-structured interviews from purposively selected Grade 3 teachers. Data was analysed using an inductive thematic framework. The findings revealed that Grade 3 learners given mathematics problems on computational difficulties were able to get timeous and specific teaching support. Based on the findings, it was recommended that effective instructions that are tailor made to address individual weaknesses and grade specific competences in mathematical computations should be used to support learner performance.

INTRODUCTION

This paper is part of a larger PhD study that focused on Grade 3 learners' challenges in mathematics computation (Machaba 2013). Learner challenges in mathematics computation could have manifested in the earlier stages and become worse with time. Evidence coordinated by the Global Child Development Group, supported by the United Nations Child is Fund (UNICEF 2006), indicates that the results pertaining to South Africa are similar to those in other countries. Their poor backgrounds can negatively affect learners' mathematical abilities (Machaba 2013).

The report by the Global Child Development Group has high-impact and cost-effective solutions. The two most important solutions that emerged from the investigation are that there should be early-education-centred programs such as group sessions or home visits. The research highlights the significance of educating mothers and of providing support to parents at home (Machaba 2013). Such programs should include good quality preschool tuition; conditional cash transfer schemes such as child grants; and educational media. The above are some of the elements suggested to tackle the risks that affect mathematical challenges amongst learners from disadvantaged environments (UNICEF 2006).

According to UNICEF's representative in South Africa, Aida Girma, over the past five years, South Africa has made great strides in improving mathematics challenges faced by learners (Alexander 2011). The number of learners enrolled in early childhood development centres increased from 16 percent to 43 percent. Such improvements in early childhood education according to Perry and MacDonald (2016) and Alexander (2011) enhanced effective teaching and learning geared toward improving academic performance in the formative years of education.

It is, therefore, significant for South Africa to continue along this trajectory, especially in rural areas and informal settlements. Informal settlements are self-erected shacks in poor communities. Learners from poor communities have a right to better education and support for any barriers that they may experience in mathematics. This paper argues that the schools that participated in the UNICEF research also experienced similar conditions and circumstances as the schools in this research paper (Machaba 2013).

Teaching Mathematics

It is undeniable that socio-economic factors influence the learning and teaching of mathematics. For example, Grade 3 learners in disadvantaged schools in South Africa's Gauteng Province experience a myriad of mathematical problems. According to Machaba (2013), most learners from disadvantaged backgrounds are unable to perform foundational mathematical operations such as multiplication, addition, subtraction and division. To prepare learners for effective learning in mathematics, basic skills should be emphasised at foundation level, which is the entry point of the South African education system. The question that guided this inquiry is: What mathematical approaches are used in teaching Grade 3 learners in South African schools?

In a survey conducted in 131 countries by the Global Competitiveness Survey of the World Economic Forum, South Africa ranks number 128 for the quality of its mathematics and science education (Modisaotsile 2012). South African education has improved quantitatively by providing access to education to a number of previously deprived communities, but the quality of education in the previously disadvantaged communities (qualitative) in comparison with other developing countries still leaves much to be desired (Modisaotsile 2012). From 1998, the high number of learners at South African schools have yielded poor outputs as indicated by the Grade 12 results. If learners experience challenges in mathematics in the Foundation Phase, they stand little chance of succeeding later in their lives (Machaba 2013).

Based on the results from an International Mathematics and Science study conducted in 2003, South Africa is at the bottom of the 46 countries that participated (Modisaotsile 2012). The countries that participated in the above study include among others, Botswana, Ghana and Saudi Arabia. Reddy (2003) noted with concern that South African learners who were older than their counterparts from countries such as Tunisia and Morocco performed poorly in Mathematics.

In South Africa, many studies conducted focused on the teaching of mathematics (MacDonald 2016). However, such studies have tended to emphasise on the teaching of mathematics at secondary schools. In addition, most studies that have sought to examine the teaching of Mathematics focus on learning and teaching materials and their influence on performance without an emphasis on teacher attributes (Machaba 2014a; Machaba and Mokhele 2014). The argument held in this paper is that the cumulative effects of learning and teaching in Mathematics begins in early grades and should be addressed early to improve learner ability. According to Machaba (2013), to have excellent Mathematics learners, it is critical to invest in effective and individual support systems to address difficulties in Foundation Phase.

Poor performance in Mathematics is not only a South African phenomenon but also a global challenge (Reddy 2003). Referring to the Australian context, Brown et al. (1998) and Van Kraayenoord and Elkins (2004) highlight variables such as failure to use differentiated learning, instructional method (whole-class teaching); failure to use differentiated learning; lack of competence in mathematics delivery; lack of language proficiency; lack of flexibility; stereotypical beliefs; and quality of educator-child interaction as contributors to poor mathematics performance.

Flores et al. (2014) assert that the content area of mathematics is a potent source for developing constructivist and cognitivist research. In this research area, themes such as learner mathematical knowledge construction, the differences between beginner and established teachers and effective instructional methods have been explored (Flores et al. 2014). From their study, Flores et al. (2014) found that mathematical problems were systematic rather than random. Such problems were a result of knowledge gaps and flaws in learner knowledge construction and interpretative experiences (Cooper and Carter 2016).

Learning difficulties that many Grade 1 learners experience in South African schools are largely due to their language proficiency in the language of learning and teaching (Botes and Mji 2010). A child with limited language proficiency in the language of teaching will continue to learn and understand at a slower rate than others, because the language is foreign to her/him (Machaba 2013). From a study by Machaba (2013), Grade 3 learners who learnt Mathematical concepts in their mother tongue performed better than those who used an additional language. Clarke (2015) mentions that limited language is a barrier to learning as learners struggle to engage in mean-

ingful learning experiences that included mathematics if their language competence is poor.

Mathematics requires of learners to be able to understand what they learn and be able to explain it when needed. Machaba (2014b, 2013) notes that learners proficiency in the language of learning and teaching either enhances or inhibits effective learning especially in the Foundation Phase. Thus, teachers teaching learners through the medium of a foreign language need to exercise patience when instructing on mathematical computations such as division, addition, multiplication and division, and use code switching until the learner is comfortable with using the foreign language. Policy makers and mathematics educators could hinder learners' abilities by separating subject language of mathematics as informal (Mercer and Sams 2006).

RESEARCH METHODOLOGY

In order to explore the Grade 3 teachers' views on teaching and learning approaches in Mathematics computation, a qualitative case study design was conducted (Du Plooy-Cilliers et al. 2014), as well as aspects of mathematics that were most problematic. 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 (Du Plooy-Cilliers et al. 2014). Data were collected using semi-structured interviews. In the context of this study, the semi-structured interview were considered appropriate as they allowed the interviewer to rephrase and repeat questions to help participants explain their approaches to teaching computations in mathematics in full (Machaba 2013). Five teachers from different previously disadvantaged schools were interviewed and observed while conducting lessons in class. The school principal and governing body gave permission and the participants answered questions from semi-structured interviews. The semi-structured interviews took place during school hours and lasted approximately 30 minutes. The interviews conducted happened in a face-to-face setting with each individual participant (Creswell 2016). All participants answered the following questions:

- Which approaches do teachers use when teaching mathematics?
- How do they resolve the problem?
- How did you identify children who experience mathematics difficulties?
- How did the Foundation for Learning Campaign help in the teaching of mathematics?

Sampling

Purposive sampling used for this research, was the most appropriate method because it targeted a specific population. The criteria for sampling allowed for the selection of specific schools. The criteria used for selecting the five schools was poor performance in mathematics in Mamelodi Township in the Tshwane South district of the Gauteng Province in South Africa. The researcher considered certain specific characteristics when selecting this sample. These included, children in Grade 3, from ages nine and ten, as well as Grade three teachers, in the previously disadvantaged areas. In each school, one teacher per school was sampled since all the schools had only one Grade 3 class. The focus was on Grade 3 teachers' teaching activities, and children's responses to teaching. Observation was based on what teachers taught and whether they offered learning support to children experiencing problems. The rationale for the choice of this sampling procedure was to obtain depth and the richest possible source of information to answer the research questions. Purposive sampling decisions are not only restricted to the selection of participants but also involve settings, incidents, events and activities to be included for the data collection.

Data Collection

Data collected from participants using semi-structured interviews occurred in three phases. This allowed for additional probing and rephrasing of questions asked to get more clarity and greater depth in meanings (Creswell 2016). Interviews lasted approximately 20–30 minutes. The observation tool used allowed for the researcher to get a clear picture of what approaches teachers used in the teaching of mathematics, how they interacted with the children; and how the children participated during mathematics teaching. The major aim of the observation was to see how learners listen while watching

what the teacher was doing. Official documents like children's books, teacher's work schedule, referral forms, and timetable and mathematics curriculum were analysed for further information on how teachers teach mathematics in Grade 3. Data acquired from the interviews and observation about classroom activities generated themes. The interview questions assisted in the development of an observation schedule. The researcher observed five mathematics lessons at each school (Machaba 2013). The findings from the data collected presented the following findings.

RESULTS AND DISCUSSION

Teaching Mathematics Computation: Exploring the Teachers' Approaches

The teachers who were participants in this study were asked about their teaching strategies for Mathematics computation. The researcher was interested in exploring the type of approaches that teachers used and how effective they were in supporting learning. In addition, the researcher noted that the teaching approaches contributed to poor performance in Mathematics computation (Machaba 2013). The participants' responses to this question varied. While programs such as Foundations for Learning Campaign (FFLC) were used, the participants indicated their lack of familiarity with Annual National Assessment (ANA), and Gauteng Province Literacy Strategy (GPLS), that are examples of South African Grade 3 national examinations. It is interesting to note that teachers were still to be trained to understand the demands of the Continuous Assessment Policy Statement (CAPS) during the period the researcher was collecting data. The teachers indicated confusion concerning the use of the current policies while they were already undergoing training in a new policy. Therefore the teaching strategy that the teachers were supposed to use was both difficult to understand and confusing (Machaba 2013). This is despite the fact that officials from the Department of Education expect to see an improved learner performance in Mathematics.

Understanding Problematic Areas in Mathematics

Under this theme, participants answered the question aimed at finding out specific aspects that were most problematic from the teaching point of view or from learner understanding. The teachers' highlighted out that, the problematic aspects were general and were related to the use of different cultural languages, which varied from the Language of Learning and Teaching (LOLT) at the school. Almost all the learners came from different ethnic groups and spoke a different language from the LOLT. According to Li et al. (2016), this was further compounded by the presence of learners from foreign countries who also spoke additional different languages, which the teachers themselves could not speak nor understand. The situation is almost dire for foreign learners as communication with them is severely impacted. In classes where local languages were used, mathematical concepts were at times difficult to explain as no local equivalent was found, for example *multiplication* [carrying over]; *division* [remainder]; *addition* [to a lesser extent]; *subtraction* [where they have to borrow] and terms such as pyramid.

One of the participants, Teacher A highlighted that,

Mathematics in Grade 3 is not much of a challenge, but the problem is the numerical concepts. He/she also alleged that language is a main problem, as learners need to understand concepts in English. We are supposed to teach the learners in their mother tongue. There is difference in mother tongue and home language; now you have to teach learners in their mother tongue, the learners have different home languages and the concepts are written in English. The challenges they are faced with as teachers are how they deal with the concepts not the content. It is not easy to translate the concept to the level that the learners would understand.

Solving the Mathematics Problems

This question was asked in order to determine what the teachers do in an effort to solve the problems they encounter in teaching mathematics and whether specialists or specialist institutions were involved in helping learners with mathematics problems (Galindo and Sonnenschein 2016). The procedure followed to determine how teachers/schools solved the problem was explored to discover whether the same route was followed in solving problems or not. The purpose was also to observe the extent to which

the intervention supported the learner's mathematical computation abilities. From the findings, learners with mathematical problems were being supported through remedial work. Learners were given easier problems and assisted through examples from the previous grade (Grade 2) to solve the persisting problems (Machaba 2013); however, the intervention success was minimal due to the different strategies used in solving problems. This practice actually lowered the standard of mathematics teaching in Grade 3, as it postponed the problem until later and consequently reduced the standards.

MacDonald (2016) states that another solution was asking parents to assist in helping learners with homework. This request is rarely acceded to because most parents work far and return home late. Some parents are themselves illiterate and cannot be of any assistance to the learners. Learners with physical leaning barriers such as sight and hearing were referred to specialists. However, learners who still did not perform as expected were referred to the schools' School Base Support Team (SBST) for further assistance. The irony of this is that some of the members of the SBST were not even experienced in teaching mathematics at grade three or teaching at Foundation Phase. If the SBST also failed to remedy the problem, the school then invited a specialist from the education departments' district office to intervene as the problem goes beyond the school.

Identification of Learners Having Trouble in Mathematics

The participants answered this question in order to understand the strategies that the teachers used to recognize learners who experience problems in learning mathematics and to ascertain whether the methods were effective or not. The teachers indicated that learners' learning problems identified were through (learners') performances in class tasks and tests.

We identify pupils performing poorly by asking oral questions and those not responding are assumed to be having problems. Report cards from the previous grade (Grade 2) indicate learners with problems. Some learners, it is alleged, were identifiable by their (the learners') failure to participate in-group discussions.

The researcher was interested in understanding how teachers recognise learners with difficulties in Mathematics. The aim of the question was to explore the ways teachers use in identifying learners with difficulty in Mathematics and the support they were provided with (Perry and MacDonald 2016). By being able to identify the learners' problems in Mathematics, teachers were able to provide individualised support and guide learners to effective learning. All the participants agreed that:

Learners' struggled through tasks, tests, and failed to respond/give feedback. They also use observation books from the previous grade.

While the participants indicated that they were able to recognise learners' difficulties in Mathematics, they were unable to add details as to how they did this. However, some learners who knew the answers would not be able to answer the questions due to the lack of vocabulary to do so. Mental arithmetic used by the teachers to identify learners' with difficulties worked as a strategy in Mathematics. The learners' failure to provide feedback and perform well in assessments was used as a strategy of identifying their challenges in Mathematics. Interestingly, the participants did not highlight that they used previous grades observation books as a strategy of identifying mathematical challenges. Some of the teachers mentioned that they identified the challenges by how the learners reacted to the remedial or intervention strategy developed to meet their individual weaknesses.

Foundation for Learning Campaign in the Teaching of Mathematics: What is its Role?

The purpose of this question was to explore the efficiency of the Foundation for Learning Campaign (FFLC) as a strategy for addressing learners' problems indicated that the campaign did not improve the situation completely, and that it was a futile exercise (Fielding-Wells and Makar 2015). On further inquiry on how the participants saw the campaign as easy to use and manage, revealed that:

The campaign is effective, as it saves them time by providing lesson preparations. The learners' prior learning was tested by doing oral work, and learners are able to count and they enjoy working in groups. Very few said that the duration for teacher training was too short.

Although the campaign supported the learners to improve their mathematics performances,

most of the interviewed teachers said it was to a limited extent. The biggest challenge for teachers was that the FFLC had too much content to be able to effectively support the learners. Although the DoE officials provided materials for FFLC, this was done without proper preparation. The majority of the teachers agreed that,

FFLC helps in teaching mathematics. It is easy to use and the teachers have learned good methods from the campaign. The campaign also helps teachers to tackle most of the activities very easily. More training is needed in order to be able to use the program fully.

Some of the participants highlighted that the FFLC provided learning, teaching material that motivated their learners to be involved in their Mathematics class.

Document Analysis

Documents are critical and important bases of evidence (Du Plooy-Cilliers et al. 2014). This was shown in this study, because the researcher could examine the educational documents such as syllabi and policies to explore the learners' challenges and their teachers' training to help them achieve the aims of the subject. These documents were analysed in the following way:

Mathematics Policy

The teachers provided the mathematics policy document (NCS). The goal was to discover if schools implemented the policy requirements. Although in its last year of implementation, participants highlighted that, they still utilised the FFLC policy.

In all the sampled schools, the FFLC policy was stored as a hard copy and implemented in all Grade 3 classrooms. However, none of the schools had the Grade 3 Mathematics Policy for Grade 3.

The FFLC Strategy

Teachers were asked if the FFLC strategy improved their mathematics teaching and learners' performance. Although agreeing that the FFLC was a good program, the teachers argued that they had challenges with its implementation. The challenges that the teachers had were the numerous activities that had to be done in the program (FFLC), which were impossible to do in one week. Many learners experiencing mathematics problems lagged behind and that hampered the process of continuity. The participants noted that tight class schedule limited meaningful learning experience of the campaign; hence, the struggle to move forward.

The teachers also alleged that the training provided for the campaign was too short (two weeks) and they still struggled with assessment, which was not made clear in the FFLC document. Although teachers appreciated the fact that the FFLC saved them time, as they only had to tick the work done, they charged that the major problem with the FFLC was the teaching of concepts. Some concepts that they had to teach were completely new to learners, for instance, *pyramid* is not available in the African languages; thus the LOLT cannot be code switched. Most schools used the FFLC strategy documents, and the researcher requested to see the FFLC documents to establish what the teachers were doing at the time. Generally, teachers and learners engaged in the lessons and activities in the FFLC in a hands-on manner. However, the researcher questioned why the teachers were not at the same level with the activities. Teachers seemed to enjoy and implement the FFLC, though it was challenging to learners. At most, schools, learners demonstrated interest in the mathematics lessons, even though they struggled to understand the LOLT.

Learners' Books

When requested to provide the researcher with learners' activity books to find out learners' performance and level of competency, as well as problems experienced by learners and how the teachers assessed the learners, the teachers provided the books, but indicated that the learners were unable to do their tasks correctly and had been promoted or "pushed" from Grade 2. Learners struggled to understand instructions given in the LOLT, since all the learners were not English speaking. The teachers provided samples of their leaners' work. From this work, the researcher was able to identify the mathematical challenges that learners encounter and the intervention strategies that the teachers used to mitigate them. From the researcher's field diary, learners in most of the sampled schools experienced serious dyscalculia difficulties. A few learners demonstrated severe mathematics difficulties (Clarke 2015).

Referral Forms

At most, the SBST teams of the sampled schools provided the researcher with their referral forms. Some of the SBST schools were not able to share with the researcher their referral forms on how they supported learners' with mathematical challenges. The analysis of the referral forms provided the researchers with information on the frequency of the mathematical problems and the support that the teacher offered. The participants who had a functional SBST in their schools explained that they supported the learners by identifying and recording learners' difficulties. The teachers then provided the necessary intervention and if the learner still did not show any improvement, the class teacher would refer the child to the grade representative who would then intervene. The grade representative recorded all the interventions given to the child and if there was no improvement the child would be referred to the school SBST coordinator, who would also have to intervene further.

If there was no enhancement, the multi-disciplinary team was invited by the SBST coordinator to find a solution. The report by the multi-disciplinary team recommends an intervention if there was no improvement in the school. On behalf of the multi-disciplinary team, the SBST coordinator sends a "450 form" (Intervention Support Form) to the District-Based Support Team (DBST). For their part, the DBST closely looks at the recommendations and generate an Education for Learners with Special Educational Needs (ELSEN) number for the learner to be referred before special school. The participants indicated that the preparation of the referral forms (450) was tedious process that in practice was not assisting learners with their mathematical challenges. Schools that did not have an SBST did not have intervention programs to support learners who experienced mathematics difficulties (Wong 2015).

Teachers' Work Schedules

On request to provide their work schedules, the researcher intended to see how the teachers used the work schedules, the type of resources and approaches for teaching mathematics. The researcher tried to find out how the work schedule catered for individual learners, groups and for the entire class. The work schedule included activities for various kinds of learners and not for the capable ones only. The researcher checked the assessments to compare them with how teachers did the actual assessment, and whether the teachers adhered to the content of the work schedule or deviated from it.

The tasks that the teachers are expected to support learners complete are too many and confusing, for example teaching learners addition, halving and multiplication in one week. The participants indicated that such task were too many for learners to engage in meaningful learning. The researcher realised that teachers at all schools that participated in this research followed different themes, although they used the same mathematics document –the FFLC and well prepared work schedules. Most teachers gave the same tasks to all learners, irrespective of whether the learners understood them or not. Alternatively, teachers could use other activities, tasks and work schedules to accommodate variety of ways learners' access and construct knowledge.

There is an urgent need for teachers to use a variety of approaches when teaching mathematics. The rational for using different approaches will enhance all children to be able to learn by talking and interacting with their peers and by engaging in argumentation, justification, and reasoning in whole-class discussions. In discussion-oriented classrooms, learner's responses inform the teacher questions and shape the course of the classroom talk. In particular, the teacher validates particular learners' ideas by incorporating their responses into subsequent questions.

CONCLUSION

From the findings, this study indicates that learners' ethnicity and socio-economic backgrounds and ethnic minorities are most at risk of educational barriers and failure in mathematics. Without attention paid to them, barriers would increase overtime and eventually lead to lack of self-esteem and finally failure. That is why it is of the utmost importance that learners who experience mathematical barriers are identified earlier in the Foundation Phase. Remedial programs that support learner mathematical development should be used once the barriers to effective learning have been identified. Learners in the

remediation program can exit it once they have overcome the barriers or are replaced by others.

RECOMMENDATIONS

To address the issue of teaching approaches, it is important that teachers use a variety of teaching methods in order to accommodate all learners and to encourage learners by using concrete objects.

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