



*Deepening the quality of mathematics teaching and learning*

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# INVESTIGATING TEACHERS' REFLECTIONS ON TEACHING THROUGH LESSON STUDY.

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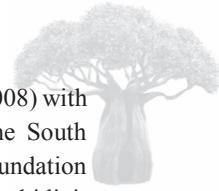
South African Numeracy Chair Project

*In this paper I share a proposed study aimed at investigating teacher reflection on the teaching of a particular topic in the context of lesson study. Lesson study is becoming an increasingly popular form of professional development around the world and more recently it is being investigated within the South African context (see for example Pillay, 2014b). In this paper, I provide some general context and literature review as to why an investigation into teacher reflections on lesson study is important within both the South African context and in relation to my role as Foundation Phase Mathematics subject adviser at Dr. Kenneth Kaunda district in the North West Province of South Africa. The topic of my focus was prompted by the observations made while fulfilling my professional responsibilities. From my numerous school visits, it is apparent that many learners have problems when it comes to multidigit subtraction. Hence, the purpose of my proposed study is to investigate teacher reflections on the teaching of multidigit subtraction to Grade 3 learners. It is envisaged that this inquiry will be carried out through the use of a lesson study involving foundation phase teachers. The interpretive qualitative research paradigm supports this study and a case study approach will be used to conduct this research. Vygotsky's socio-cultural perspective of teaching and learning will guide both data collection and analysis. The findings of this study should point to possible solutions to the challenges encountered in the teaching of multidigit subtraction in my area and I also plan to incorporate these into my future work with teachers.*

## **INTRODUCTION**

The South African education system is faced with a serious challenge in which learners struggle with the basic concepts of Mathematics. For example, in the 2003 Trends in Mathematics and Science Study (TIMSS) international study of science and mathematics teaching in various countries around the world, South African learners did not perform well at all, being placed at the bottom. Furthermore, the inequality of performance between South African learners in these studies is increasing (Reddy, 2006). According to Reddy (2006), this could be attributed to a multitude of factors including teacher development.

Selter (2002) argues that researchers do not know much about children's mathematics with respect to an array of topics. This applies, for example, to addition and subtraction with three-digit numbers. According to Selter (2002), there are few research reports concerning multidigit subtraction, other than for instance, the report by Fuson *et al.* (1997). Graven, Venkat, Westaway and Tshesane (2013) point to gaps in mathematics



teacher content knowledge and pedagogic content knowledge (Carnoy *et al.*, 2008) with foundation phase addition and subtraction of multidigit numbers within the South African context. Similarly, in my work as Subject Adviser responsible for Foundation Phase Mathematics I have noted that learners struggle with the subtraction of multidigit numbers. This observation was made during my numerous visits to various Grade 3 mathematics classrooms. Hence there is a need to investigate possible solutions to the challenges encountered in mathematics especially in our previously disadvantaged poor performing schools.

Local and international research does however points to the problem of the prevalence of rote/ ritualised methods as opposed to developing conceptual number sense for teaching addition and subtraction of multidigit numbers (Graven, et al.2013; Selter, 2002; Fosnot & Dolk, 2001). Furthermore, research also points to a range of strategies that can be used to support learners in developing number sense and proficiency in multidigit computations.

While Fosnot and Dolk (2001) agree that ‘algorithms - a structured series of procedures that can be used across problems, regardless of the numbers – do have an important place in mathematics’ (p. 124), they emphasize that this should only come after the students have a ‘deep understanding of number relationships and operations and have developed a repertoire of computation strategies’ (p. 124).

I discovered in my area that the problem with algorithmic methods is that the learners use them without understanding. I experienced the above-stated problem as both a teacher and as a district subject adviser. For example, during my numerous schools visits in Maquassi Hills, I have observed that some learners do the following when subtracting:

92

- 76

24

Graven *et al.* (2013) provide similar anecdotal experiences of learners who were attending in Eastern Cape and Gauteng primary schools. In addition, two-digit subtraction problems that require borrowing pose a serious challenge to learners. In essence, the solution provided by the learner as illustrated above suggests that the learner subtracted the units and the tens as per the algorithm but erroneously adhered to the principle of ‘always subtract the smaller from the bigger’. Thus, in the above case, the learner lacks two key strands of mathematical proficiency, namely; procedural fluency and conceptual understanding (Kilpatrick, Swafford and Findell 2011). In my view, these student errors show that students focus on trying to remember the steps of

algorithm but do not make sense of numbers (Clements & Sarama, 2014). According to what is stated above, it might be wise if we do not teach algorithm (Clements & Sarama, 2014) to foundation phase learners if we want learners to grasp and develop number sense. The preceding statement by Clements & Sarama, 2014 coheres with the South African Curriculum and Assessment Policy Statement (CAPS) for Mathematics in the Foundation Phase for Grade 3 which states that learners should “understand subtraction and use subtraction vocabulary by the end of the year” (DBE, 2011, 322). Thus, the Curriculum and Assessment Policy Statement for Foundation Phase does not promote or suggest the use of algorithms. Perhaps, this explains why the departmentally issued Grade 3 Numeracy workbooks do not include the vertical algorithm method but instead suggest variety of methods.

The 2013 ANA marking memorandum for Grade 3 shows the following options as ‘valid method for multidigit subtraction at this level:

9.1

$$\begin{aligned}
 &795 - 213 \\
 &= 700 + 90 + 5 - 200 - 10 - 3 \\
 &= 700 - 200 + 90 - 10 + 5 - 3 \quad \checkmark \\
 &= 500 + 80 + 2 \\
 &= 582 \quad \checkmark
 \end{aligned}$$

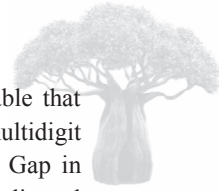
or

$$\begin{aligned}
 &5 - 3 = 2 \quad \checkmark \\
 &90 - 10 = 80 \quad \checkmark \\
 &\underline{700 - 200 = 500} \\
 &795 - 213 = 582 \quad \checkmark
 \end{aligned}$$

or

$$\begin{array}{ccccccc}
 \checkmark & & & & & & \checkmark \\
 795 - 200 & \rightarrow & 595 - 10 & \rightarrow & 585 - 3 & \rightarrow & 582
 \end{array}$$

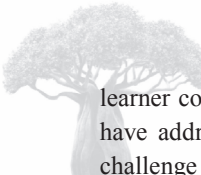
However since the algorithm method is suggested in the CAPS for Mathematics in the Intermediate Phase (DBE, 2011b) and many teachers themselves use this method for their own calculations, these methods are often found (erroneously executed) in grade 3 classrooms in my area. Additionally, the first two methods indicated in the memorandum above do not work well when, for example, a larger unit is subtracted from a smaller unit as in the case of  $23 - 19$  where many learners answer  $20 - 10 = 10$  and  $9 - 3 = 6$  so  $23 - 9 = 16$ .



A scan of literature shows that there is little local research currently available that addresses, *from a classroom teaching perspective*, challenges with teaching multidigit subtraction and how to *address* the widely noted ‘common errors’ such as Gap in research on local teacher informed reflection on practice. Departmentally coordinated in-service teacher development in SA has been widely criticised for being predominantly ‘lecture style’ and largely ineffective since it does not sufficiently take into account classroom conditions and existing teaching practices (Chisholm *et al.*; 2000; Graven, 2004; Pausigere & Graven, 2013). I perceive teacher development that is separated from classroom practice as lacking a key learning opportunity and a possible reason for the widespread failure of much teacher development in SA.

Indeed, in their Integrated Strategic Planning Framework for Teacher Education and Development South Africa 2011 – 2025, the Department of Basic Education and Department of Higher Education Training (2011) acknowledge that there is a need for a new approach to teacher development. Here they emphasise the need for localised teacher support through the development of subject based professional learning communities (PLCs). In my professional capacity, as already referred to in the preceding paragraphs, I initiated after school Maths Clubs in the area with six Foundation Phase Grade 3 teachers. This was done in an attempt to address the subtraction of multidigit in foundation phase and various other mathematics challenges. To this end, in 2012 I began collaborating with the South African Numeracy Chair Project (SANCP) which is based at Rhodes University and in particular began working with their notion of after school mathematics clubs (Graven, 2011). The initiation of the maths clubs was motivated by my first interaction with members of the SANCP and the clubs were structured in line with the design suggestions of Graven & Stott (2012) and Stott & Graven (2013). The clubs have typically 25 Grade 3 learners from four different schools. Teachers chose to take learners from different schools in order to see various ways of working. Through my collaboration with SANCP I am planning to conduct an inquiry or research that will enable me to improve my support of teachers in my current district role and also to shed light on the opportunities of lesson study as a form of professional development for clusters of teachers. I would like to explore teacher reflection that foregrounds strengthening local teaching practice of the particular topic of multidigit subtraction through joint planning, implementation and reflection on classroom teaching. In this respect a lesson study approach (Fernandez, 2002) will maintain this exploration because within this approach there is a strong emphasis on reflection on practice.

Having developed strong relationships with these teachers through these clubs provides me with an opportunity to develop a professional learning community (PLC) with these teachers focused on lesson study. When visiting with these teachers in their after school maths clubs they have often shared with me several challenges they have noticed with



learner computations from the different schools. Additionally, they shared ways they have addressed these with individual or small groups of learners in these clubs. A challenge for them, however, is how to draw on these insights in order to address the challenges in their Grade 3 school classrooms with about 45 learners per class.

This study will be guided by an assumption that language is central in the learning and teaching of mathematics. As such I will draw on a Vygotsky's socio-cultural perspective of teaching and learning to frame my study and data analysis. In this respect and given the above, I hope to offer lesson study focused on multidigit subtraction as an opportunity for drawing together these six teachers insights and reflections on designing a lesson for the teaching of multidigit subtraction and reflection on that lesson for improved teacher understanding. However Likando (2014) notes that adaptations need to be made when using lesson study in culturally different contexts such as the USA and I would expect some adaptations within the South African context. According to Lewis and colleagues (Lewis, et al., 2006) lesson study was also used successfully in the UK to improve the teachers' pedagogy. In my view, lesson study is a useful opportunity for both improving teacher practice in the classroom as well as stimulating teacher reflection and thus provides a rich empirical field enabling me to gather data on teacher reflection on a particular topic of interest (in this case multidigit subtraction). Thus this collaboratively planned, taught, observed, reflection process of lesson study will provide a useful opportunity for my study on teacher reflection and insights into multidigit (three digit) subtractions.

I intend to adapt lesson study in relation to teacher participation. As such the number of lesson cycles and who will teach the lesson will be jointly planned and will be openly negotiated. Additionally, should they all wish to be involved in the lesson, all teachers may participate in a team teaching lesson approach. In my role as subject adviser I will arrange for permission for teachers to jointly participate/observe in this lesson that will take place in one Grade 3 classroom. All schools are within a 5km radius of each other enabling this possibility.

In this respect the research and lesson design study aims to:

- \* Develop reflective insights on how to address the problem of multidigit subtraction in Maquassi Hills Grade 3 classrooms through a focus on designing and analyzing a lesson focused on the teaching of this.
- \* Research teacher reflective insights on the teaching of this topic and the enablers and constraints of participation in this lesson study process.



Thus addressing the central question for this study is: What are teachers' reflections and insights/strategies on the teaching of multidigit subtraction (as revealed through participation in lesson study lesson on the teaching of it to Grade 3 classrooms)?

The unit of analysis will be teacher reflection as communicated in the lesson study sessions. This data will be primarily obtained from transcriptions derived from video recordings of sessions. Additionally teacher reflection data on this topic will be derived from post lesson study individual semi-structured interviews with each of the participating teachers.

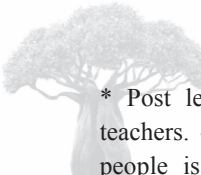
## **RESEARCH DESIGN AND METHODOLOGY**

This collaborative 'lesson study' will form the empirical field of my research. Given the choice of lesson study as the empirical field and teacher reflection and insights on the teaching of multidigit subtraction as the focus of my research it is appropriate to use an interpretive qualitative research paradigm. It will underpin this study with a multiple case study approach. The multiple cases will be the 6 teachers participating in the lesson study professional development cycle.

The participants will be invited from the opportunity sample of teachers that I have been working with in 2014. As indicated above I have developed good working relationships with six Grade 3 teachers through our mathematics club work in 2014. I have thus selected (to invite) these teachers because I am already working with them in foundation phase and their work and their demonstrated interest in strengthening their teaching provides me with an opportunity. I intend to be a participant observer within the lesson study. My role as a participant observer would be to observe the event as it would be "naturally occurring" (Macmillan & Schumacher, 1997) at the "field site" (Neuman, 2011). I would also write notes to "describe what people did and said" (Kelly, 2006). While a participating member of the lesson study even while I will additionally assume a co-coordinating role. As their mathematics subject adviser I will be particularly aware of possible power relations that might influence the process and their participation. I will endeavour to establish a partnership with them in the investigation. The schools and teachers also provide a convenient sample of teachers as their schools are situated nearer to my place. Therefore, it will be easier for me to visit these schools.

My methods of data collection will primarily involve:

\* Video recording of all lesson study sessions - Since teacher talk (reflection, strategies and insights) is the unit of analysis for this study, video recordings will be fully transcribed, it is envisaged that video recording will be used to capture all lesson study sessions. Member checks will be used to support accuracy.



\* Post lesson study semi-structured one-to-one interviews with all participating teachers. - These will be audio recorded and fully transcribed. Since “interviewing people is a natural way of interacting with people than making them fill out questionnaires or do a test” (Kelly 2006: 297) one-on-one interviews will be used in this study. A semi-structured interview schedule will be designed following the lesson study process before the interviews are conducted. The interview questions on the interview schedule will be in line with the research questions developed for this study. In essence, they will be given an opportunity to explain how they believe the invented strategies can be used to develop an understanding of multi-digit subtraction.

\* Researcher/participant journal – I would record interactions (Phelps, 2005) with the participants at my field site, as well as the ‘informal’ dialogue between me and the teachers that may occur outside of the recorded lesson study sessions.

\* The constructed lesson plans of the planning sessions. - The documentary analysis of the lesson plans developed in the lesson study process will provide rich data on strategies and insights developed by the teachers.

Thematic analysis of the teacher insights and reflections present in lesson study session transcripts will be conducted. I will draw on Lee’s (2005, p.703) framework of reflection to assist in this analysis. This framework provides three levels of teacher reflection:

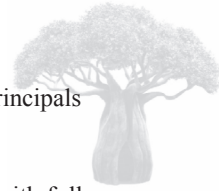
Level 1 – Recall: When the teacher provides simple description of their initial teaching experience, from what their own past experience as teacher or learner of the particular mathematical topic. Further express why they use a certain approach to teach the topic.

Level 2 – Rationalization: When the teacher describes how they start to question their belief about teaching a topic in a particular way. Thus seeks to look for their belief about teaching a topic in a particular way. Thus seeks to look for alternative ways that relates to change their past experience. The teacher develops a relational meaning of mathematical teaching and learning experiences.

Level 3 – Reflectivity: The teacher shows an awareness of various perspectives and is intent to change/improve, and is able to see the influence of their cooperating teachers on their learners’ values/behaviour/achievement.

Informed consent, respect for the rights of research participants, confidentiality and anonymity are some of the ethical considerations that I will attend to prior to conducting the investigation. For example, I will write letters to the North West Department of



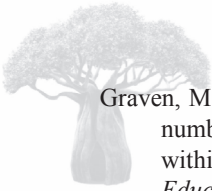


Education, the Education District Director of Maquassi Hills and the school principals to request permission to conduct my research investigation.

Similarly, during the recruitment process I will provide potential participants with full details concerning the purposes of and the manner in which the study will be conducted. I will also assure them that their participation will be both anonymous and confidential. In this regard, I will indicate that their names and those of their schools will not be used anywhere in the documents that will form part of the study. I shall strive to use codes and/ or pseudonyms for this purpose (anonymity).

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