PRIMARY TEACHING LEARNING THROUGH PARTICIPATING IN A MATHEMATICS CLUB PROGRAMME:

THE STORY OF MANDIE

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This paper illustrates primary teacher learning through participating in a mathematics club programme. The programme is structured as a teacher development programme that enhances teaching and learning of mathematics and also as a strategy to improve learner performance. I have provided a vignette of Mandie (one of the thirteen teachers) who participated in a mathematics club programme (Pushing for Progression) who illustrates her learning through participating in the programme. I have used Wenger's four categories of learning namely: meaning, practice, identity and community (Wenger, 1998), including a fifth important component confidence (Graven, 2002), to organise the data, by means of textured quotations to illustrate Mandie's learning. The study shows how Mandie displayed evidence of improvement in terms of teaching and the way in which she engaged learners more in the teaching and learning of mathematics.

Key words: after school maths clubs, Pushing for Progression, teacher learning, and communities of practice

INTRODUCTION

The paper focuses on a story of 'Mandie' that emerges from a broader project in which, as part of my PhD studies I explore the nature of teacher learning through participation in the "Pushing for Progression" (PfP) programme. The PfP programme was conducted by the South African Numeracy Chair (SANC) project focused on developing learners' number sense and fluency in the four basic operations (Graven & Stott, 2016). It ran over a fifteen-week period from May 2016 to August 2016. During the PfP programme, teachers were engaged in a professional community of teachers, as club practitioners with academic researchers and departmental officials, where they share their experiences of running after school maths clubs. Participation in the PfP programme project and community of practice is conceptualised by learning as teachers are engaged in activities on how learners progress from using concrete strategies to solve problems to more flexible and efficient strategies.

By means of rich and textured vignettes and quotations, this paper illustrates Mandie's learning in terms of the four components of learning identified in communities of practice (COP) by Wenger's four categories of learning and 'confidence' by Graven (2002). During the programme teachers ran after school maths clubs and participated in regular sessions with myself, as facilitator in the Eastern Cape Department of Education (EC DoE), a PfP co-ordinator from Rhodes University and fellow district officials. Mandie's story is drawn from a broader research study in which I focus on my research question: What is the nature of teacher learning through their participation in after school mathematics clubs and in a community of after school club facilitators? The research is a qualitative case study, the data collected involved interviews, stimulus recall interviews on video recorded club sessions, teacher reflective questionnaires, workshop observations, individual club observations, community of club facilitator's reflections and teacher learning journals.

THE CONTEXT OF THE STUDY

South Africa is currently embarking on achieving improvement in the quality of teaching and learning in schools for children to be able to succeed in the 21st century society (DBE, 2015). Poor learner performance in mathematics is well documented in both national and international studies, for example the Annual National Assessments (ANA) (DBE, 2014a) and the Trends in International Mathematics and Science Study (TIMSS) (Mullis et al., 2012).This poor learner performance in mathematics is mirrored in the performance of South African teachers in the comparative study conducted by Carnoy et al., (2008) as well as in the statistics from the latest Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) III study (Moloi & Chetty, 2010). According to Scholar, (2008) children are still relying on simple unit counting to solve problems and concrete counting strategies. In the Foundation Phase there is evidence of a lack of shift from concrete counting-based strategies to more abstract calculation-based strategies (Ensor et al., 2009). In the study conducted by Venkat and Naidoo (2012) this highlighted

that concrete counting based strategies in the Foundation Phase has resulted in low rates of task completion within and across lessons. Wietz (2014) in her research has pointed the need for supporting teachers in ways that model progression of learners. The PfP programme as a SANC project initiative was developed in order to develop learners' number sense and fluency and increasing efficient strategies in the four basic operations.

THEORETICAL FRAMEWORK

The study draws on Wenger's social theory of learning (Wenger, 1998) which regards learning as social participation within a community of practice. Learning as participation in the social world, the emphasis is on the relational interdependency of individuals (Lave & Wenger, 1991; Lave, 1993b, p. 67). This theory regards learning as social participation which broadly implies socially negotiated meaning, active participation in practices of communities and identity. Teacher's participation in a collaborative community involved the combination of various components of learning, namely: meaning, practice, identity, community and confidence (Lave, 1996; Wenger, 1998; Graven, 2002; Wenger et al., 2002; Pausigere and Graven, 2014).

These components of learning are defined as follows:

- Meaning is a way of talking about our ability to experience the world as meaningful;
- Practice is a way of talking about shared historical and social resources, frameworks and perspectives that sustain mutual engagement in action;
- Community is a way of talking about the social configurations in which our enterprise is defined and our participation is recognisable as competence;
- Identity is a way of talking about how learning changes who we are;

Figure 1: Components of a social theory of learning: An initial inventory (Wenger, 1998, p. 5)

I used Wenger's various components of a social theory of learning as the lens through which I analysed the data. For Wenger (1998), meaning is located in a process called negotiation of meaning, which involves the interaction of the processes called participation and reification. Wenger's use of the term participation is the same as its "common usage" (p.55). It describes the 'social experience of living in the world in terms of membership in social communities and active involvement in social enterprises' (Wenger, 1998, p.55).

Wenger's theory (1998) explores the intersection of the learning components: community, practice, meaning and identity. In the research conducted by Graven another approach of learning "confidence" (Graven, 2002, pp. 303-304) emerged, as a product and a process of learning enabled the teachers in the study to move from being teachers of mathematics towards being and becoming competent and confident mathematics teachers. Graven (2002) in her study began to see learning as an integral part of being a professional, irrespective of one's level of formal education. Graven (2002, p. 203) relates "confidence" to learning to become a confident "masterful" professional mathematics teacher. Confidence is closely intertwined with all four of Wenger's learning components as an overarching fifth component which explains individual teacher's ways of learning through experiencing, doing, being, and belonging.

DATA AND METHODS

Mandie's story emerges from my broader qualitative case study research of teacher learning within one in-service maths club programme which involved running a mathematics club and participating in the supportive collaborative community of practice of mathematics club facilitators (fellow teachers) co-ordinated by myself as a DoE subject specialist and drawing on the SANC project staff. By employing qualitative methodology was to provide rich 'thick descriptions' (Cohen et al., 2010) on the nature of teacher learning. The vignette of Mandie is constructed from interviews, stimulus recall interviews on recorded club sessions, teacher reflective questionnaires, workshop observations, individual club observations and teacher learning journals. Mandie's narrative vignette was developed from the analysis of these multiple data sources which was informed by the work of Lave & Wenger (1991) and of Wenger (1998).

Preliminary data analysis points to a range of learning for all teachers in relation to the way in which they talked about meaning in teaching, their teaching practice in the mathematics classroom, identity, belonging in communities and confidence during the course of the fifteen week programme.

However, as indicated above, in this paper I share a vignette of only one of the teachers, who I called Mandie to illustrate the nature of teacher learning in relation to the running of clubs and participating in the maths club facilitator community.

Mandie's learning story within the PfP club programme

Mandie is a qualified Foundation Phase teacher with a BEd Hons in Management. She has taught grade 1 for the past eight years. She facilitated clubs for grade 3 learners from May to October 2016. The clubs ran weekly over a fifteen week period where teachers explored the ideas presented in the workshops and reflected on how it helped them in progressing learners as well as how it influenced her own teaching and her classroom practice. I have used Wenger's four components of learning and confidence within a community of practice to structure Mandie's story.

Meaning: Learning as experience

In response to the second interview question on, what did you learn in participating in a mathematics club? Mandie responded positively by saying:

> *I gained a lot of mathematics content in the programme. When I joined the programme I could assess myself in terms of mathematics understanding and I could find that I had gaps in that, for example in the first session in PFP when we were introduced to "number sense' I had no knowledge of number sense and I never heard about it. I learnt that number sense should be developed to the learners as early in the Foundation Phase (2nd interview, January 2017).*

In the extract from the 2nd interview above, Mandie explained how she got to know about number sense and how to develop it in her learners. In her first club session when she was administering the assessment she could see that club learners were using constraint methods of drawing circles when answering the questions. She acknowledged the need for learners to progress from one to one counting to the use of efficient strategies as early as grade 1. She started with dice where learners had to move from counting the dots to be able to see six immediately. She further explained how she sees her journey in assisting the learners to expose them to different approaches (Journal entry, May 2016). Mandie explained during her participating in a mathematics club that it was easy for her to assist the learners to use different methods/ approaches in solving mathematical problems both in club sessions and class teaching (2nd interview, January 2017).

She explained how she used to teach by writing on the board and expected the learners to write the answer and use the counters to count and not allowe them to use their own strategies. She further explained that she would drill one procedure, not first develop the concept for the learners to understand. The idea of developing conceptual understanding was new to her.

> *I use to write the number sentence on the board e.g.* 7 + 4 = *and expect them to give an answer, I was teaching mathematics abstractly.*

Running the clubs exposed her on how to develop conceptual understanding in the learners. She learnt to understand that if a child has gained conceptual understanding it was easy to remember procedures and that the child could use more flexible strategies to

solve new problems. When using a procedure, a child had to reflect on the procedure used, which may in turn strengthen her conceptual understanding.

Participation in a mathematics club helped her understand the meaning of the equal sign. She was creating a misconception to the learners on the meaning of the equal sign. According to her '=' meant that learners must give the answer to the operation on the left. When learners were given the problems to solve that's how they solved it.

$8 + 5 = \square$ $8 + 5 = \square +$

> *In both cases they will give 13 to the answer but not 4 in the second one. (Journal entry June, 2016).*

Her perception of an equal sign has changed after attending the PfP programme sessions and participating in the mathematics club. By the end of the programme most of the learners gave 4 as the answer.

$8 + 5 = \square + 9$

Practice: Learning as (changing) doing

Mandie's teaching of multiplication has changed since she introduced the array to develop the concept of multiplication and the arrays are what learners see in their everyday lives. She has stated that the arrays are in the CAPS document but she never taught it.

> *Session 3 which focuses on multiplication (×) and division (÷) and how to use an array to introduce multiplication (PfP, Session Three Teacher Handbook, 2016). I never taught arrays even if it is in the policy document, I just overlooked it and I had no understanding of it. The programme has exposed me on the simplest way of introducing multiplication, learners were able to understand e.g. how I used to teach is the normal way 12 x 3 = of allowing them to draw the circles with no logic. I have found that learners enjoyed the arrays as they could see and were able to work with it (2nd interview, January 2017).*

Mandie has indicated how she used the club activities with the whole class and allowed club learners to be group leaders to assist other learners.

> *I normally take the club learners to be leaders due to the high number of learners in a class. Grouping the learners helped (COP2, August 2016).*

Mandie also indicated that in all her years of teaching mathematics the learners never progressed. She "trapped" them at the concrete stage by drilling them on one to one counting for the whole year.

> *I could put the blame on me as I was the one who trapped the learners I used to drill the learners for the whole year to use the circles to count (2nd interview, January 2017).*

Her teaching practice has changed and she demonstrated by starting a club session with a mental maths activity that focused on strategies in doubling and halving, re-ordering of numbers, rapidly recalled facts which was set in the 1-20 number range and use of bonds of 10 (club session 2, May 2016).

> *She explained how bonds of 10 assisted the learners to progress from counting using fingers. For addition she showed the learners that they can swap the numbers and count on instead of counting all to get the answer more specially in addition 3 + 5 = .../ 5 + 3 = ... (Session Two Teacher Handbook, April 2016).*

During club session 2 observations, mental maths focused on bonds of 30. There was a demonstration of progression on the development of number sense (Lesson demonstration, October 2016). In terms of understanding the level in terms of strategies learners used, she had indicated how powerful the tool was as she was able to compare learners from the first and second assessment.

> *The use of the spectrum allowed me to progress the learners and see if they use the constrained or semi constrained methods, things that I never knew before I participating in mathematics club. A correct or wrong answer is something of the past. I encourage learners to communicate their strategy. I used the spectrum not only in the club but to the whole class and that informs me as to which level my learners are operating (2nd interview, January 2017)*

She has indicated how the spectrum assisted her to be able to track learner progress, not only the club learners but also her whole class. She was able to identify which strategy her learners were mostly using as a form of diagnostic assessment and was able to intervene. In her comment her focus was not on the correct or wrong answer but on developing fluency in learners.

Mandie has indicated how she changed the way she teaches, she now demonstrates and the learners do the activity themselves. She now assists only where it is need. She based her teaching on hands on activities. During the lesson presentation she talked less and increased the use of more learner-centred methodologies and engagement with mathematical meanings in teaching. Learners own their learning and the teacher guides learning.

Participating in mathematics club also established sound homework practices. Mandie has encouraged her club learners to do their homework as individuals and for their parents to assist them. This also helped mathematical understanding to be developed as learners will bring their problematic areas to the club sessions.

> *Their books are dirty and messy which gives the evidence that these are being used. Learners could be able to bring the challenging questions to clubs and give us a chance to revise areas that were challenging. Homework also draws parents close to school, they could come and explain how they supported the learners (2nd interview, January 2017)*

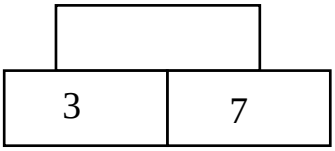
Change in Identity

In the first interview this is how Mandie responded on how she can describe herself as a teacher

> *I'm good but I cannot say I'm an expert but I'm willing to learn to know and to do, I have interest in Mathematics but I found that I have a gap when I couldn't assist my child who is in grade 6 when doing his mathematics homework. I think it's because I have been teaching grade 1. I love mathematics and I feel that anyone could learn mathematics. Mathematics teaching needs someone who is willing to learn because it needs practice every day. I acknowledge the fact that I have a gap in teaching mathematics but I am willing to learn mathematics As a mathematics teacher one needs to be a lifelong learner (CAPS, 2011) and in the second interview that was how she has described herself (1st interview, May 2016).*

In her second interview she explained how she has changed in that she did not feel the gap that she was having before. She can assist the learners in solving mathematical problems and even shared some of the strategies that she introduced to the learners

> *Now I don't feel any gap that I used to have. I can choose any strategy to apply in a mathematics problem to any number range now. Practising the skill and applying the skills assisted me and the learners. I have exposed my learners to part - part whole,*



> *I do not only use the horizontal number sentence of 3 + 7 = ____ (2nd interview, January 2017).*

Mandie also shared how she encourages her learners to communicate their strategies that they used in solving the problems.

> *Asking them questions like how did you get to the answer? Letting them share their experiences encouraged their maths thinking (Post questionnaire, November 2016).*

This was also evident in her second interview that she allows her learners to explain their answers and the strategies they used to solve the problems.

> *My learners do not only rely on counters or fingers when solving problems. I am able to progress them from counters; they can use a number line especially if they add big numbers. I used to keep them and drill them in using the circles and tallies for the whole year without exposing them to other strategies. My mental maths is not just meaningless counting. My mental maths activities link very well with the concept that is to be introduced or reinforces the concept taught, like the game on who has, in halving and doubling and halving to introduce multiplication and*

division. My learner's exercise books are messy and I allow them to make mistakes I don't encourage them to erase what they have written. (2nd interview, January 2017)

Community: Learning as belonging

She further explained how she shared the club activities in her school and how the teachers are using the club activities in their teaching. She further explained the support that she gets from her principal that he is making copies of the document for other teachers to have and effectively utilise them.

What I am doing now that I have demonstrated the club activities to all FP teachers in my school? They are using the club activities and use club resources in their classes. My principal is making copies of the teacher's book for other teachers in my school (2nd interview, January 2017)

Mandie in the second interview when asked about as to where else did she share information about the clubs she responded as follows.

In the cluster meetings I did explain them what the clubs are all about and teachers seem to be interested (2nd interview, January 2017)

She explained how she shared the club sessions with teachers in her cluster and during the Association for Mathematics Education of South Africa (AMESA) provincial conference and how teachers responded to the activities.

I have even attended the AMESA conference in Mthatha and presented the club activities; I could see their (the teachers') responses that they liked those activities and shared some of the resources with them. This also gave me confidence in the programme. (Journal entry, September 2016)

Confidence

In her second interview she explained how people outside of her school have seen a change in how she presented the mathematics lesson starting with the mental maths where all learners were involved in the activity not just counting by chanting the numbers. She could explain to them how she is now confident in teaching mathematics after she had been participating in the mathematics club.

As my school was engaged in another maths programme run by an NGO, I did a presentation where I outshined and the facilitators asked as to what can be the cause of change in my teaching. My learners were actively involved and could explain their mathematical thinking. I have improved as compared to the previous visit. Participating in a mathematics club groomed me to be confident to teach mathematics. This made me to be more confident especially if somebody from the outside could see the change in me. Even at school, teachers see me as a specialist and that I can help them if they struggle to teach some concept. We, teachers used to rely on the textbook

when teaching the learners but with participation in a mathematics club it has changed the way we teach mathematics. (2nd interview, January 2017)

Her confidence was evident also when she shared her club experience in AMESA and also in their cluster meeting.

CONCLUSION

All thirteen teachers displayed some evidence of improvement in terms of teaching and the way they are engaging learners more in teaching and learning. In this paper I have illuminated, through one teacher's learning story, the way in which participating in mathematics clubs and the related mathematics club programme creates a space for empowerment of teachers in terms of developing mathematical understanding and content knowledge and how to develop conceptual understanding in the learners. I am not claiming that this is the case for all teachers in the programme and it is too early in my data analysis to make that argument. However, what has been shown is that the club programme created an opportune space for such learning. The broader research study will investigate all 13 teachers learning in depth and hopes to contribute to both policy relating to opportunities for teacher development and to theoretical understanding of how teachers might learn from the practice of running clubs and reflecting on this practice within a broader supportive learning community.

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