Teacher perceptions of the successes and challenges of a mathematics homework drive for primary learners

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In this paper I argue for the importance of foregrounding homework as a practice that can support student learning, especially in poorer performing schools where learners lag behind with key foundational knowledge. A socio-constructivist perspective of learning informs this argument. Furthermore this paper is guided by the assumption that developing productive learning dispositions is key to supporting learning. Data from teacher questionnaires repeated annually over a two-year period provide an empirical basis to support the argument. This data emerges from 5 years of research and development work of the South African Numeracy Chair Project with twelve schools in the broader Grahamstown area. The data points to strong take-up by teachers of the homework drive project that was introduced and enabled by the provision of learner take-home workbooks. The data indicates a range of positive benefits for learners as noted by participating teachers.

Introduction, Context and Rationale

Mathematics education in South Africa is struggling according to a wide range of regional, national and international assessments (see Fleisch, 2008; Reddy al., 2015; DBE, 2014). Finding ways forward to the many challenges that contribute to poor learning and performance in this learning area is essential. A wide range of research points to critical need for addressing the challenges of mathematics education especially in the primary years where the majority of learners already fall two grades behind expectation by the intermediate phase (e.g. Taylor, 2015). These include addressing mathematics knowledge for teaching (Adler, 2005); improving teaching pedagogies that foreground sense-making (Venkat & Naidoo, 2012; Hoadley, 2012), running after school mathematics clubs aimed at extension and remediation (Graven & Stott, 2012; Stott & Graven, 2013), increasing teaching time and the opportunity to learn within schools (Carnoy et al., 2011) and so forth. All of these are important and I would argue that a combination of these strategies and related intervention projects should work together if we are to progress in turning this crisis around. However the aspect that I choose to focus on in this paper is that of extending students' opportunity to learn beyond the school day through building mathematics homework into the everyday practices of teachers and learners.

My reason for the focus on homework in this paper relates firstly to my broader research work within the South African Numeracy Chair Project (SANCP) that points towards weaknesses in primary mathematics student learning dispositions which stand in contrast to the requirements of the current Curriculum and Assessment Policy (CAPS) curriculum (DBE, 2011). Additionally I have argued that learning dispositions are a largely unexplored area of South African mathematics education research and that learning dispositions are possibly a key contributing factor to our poor comparable performance on regional studies such as Southern and East African Consortium for Monitoring Educational Quality (SACMEQ). Other Southern African countries participating in SACMEQ have similar levels of poverty, health issues such as HIV and AIDS, low parental literacy levels and language challenges and many spend far less on education than South Africa. Yet the learners in these countries outperform our learners on comparative studies in mathematics. I have thus argued that perhaps greater attention must be given to repairing the passive learning dispositions and the views that mathematics is *not* for all, promoted under apartheid. See Graven & Heyd-Metzuyanim (2014) and Graven (2014) for elaboration on the possible role of dispositions in our low levels of mathematical learning.

Within a range of literature defining key learning dispositions generally (e.g. Carr & Claxton, 2002), and productive mathematical learning dispositions more specifically (Kilpatrick, Swafford & Findell, 2001), the notion of steady effort and/or developing resilience and independence are foregrounded. Yet when our project began working with teachers and schools in the broader Grahamstown area few of them gave homework on a daily basis suggesting a wide range of reasons for this. This resonates with Spaull's (2013) findings from the SACMEQ111 results for Grade 6 South African learners that only 49.9% to 56.1% of quintile 1 and quintile 4 schools respectively give homework 'most days of the week'. Furthermore he found that:

> The only common factor in the mathematics regression which is not common in the reading regressions is the dummy variable 'received homework most days of the week.' Compared to students who never receive homework, any homework frequency is positively associated with mathematics performance in poorer schools. (Spaull, 2013, 443)

Aside from supporting performance, homework can have motivational benefits for learners and help learners develop strategies for coping with mistakes and difficulties (Bempechat, 2004) and skills in managing tasks independently (Corno & Xu, 2004). Furthermore homework can increase time spent on written learning activities where learners work independently at their own pace. At the start of the project, analysis of a sample of a range of learner books across schools pointed to low levels of written learner activity by the end of each year (see also Hoadley, 2012) and the echo of what Brombacher refers to as the 4 sums a day practice to enable teachers to comply with the regulation of marking all learner work (Graven, submitted). In this respect I felt it important that opportunities for learners to *do* mathematics increased. Additionally I wanted to increase learner opportunities for working independently, at their own pace and for consolidating and developing fluency in relation to what was learnt in class. Thus in June 2012 the 'homework drive' was introduced to all teachers participating in the Numeracy Inquiry Community of Leader Educators (NICLE) of the SANCP. This project is explained further below.

SANCP: Intervention projects and research methods

NICLE began in 2011 as the key intervention project of the SANCP at Rhodes University in the Eastern Cape. SANCP researches sustainable ways forward to the challenges in mathematics education through partnering researchers with schools catering for learners from predominantly low Socio-economic Status (SES backgrounds) in the broader Grahamstown area. The Eastern Cape is one of the poorest provinces in South Africa and has amongst the lowest ANA results. The SANCP team consists of post-graduate primary mathematics researchers, supervised by the Chair (author), who simultaneously conduct research and development projects aimed at improving primary mathematics learning in Eastern Cape schools. The SANC is one of six mathematics education Chairs in South Africa, which are funded by private foundations and the DST while administered by the NRF. As such these chairs differ from other Chairs in the SA Chairs Initiative as they are tasked with *merging* research and development objectives through *partnering* with a cluster of at least ten schools serving learners from predominantly low SES backgrounds.

NICLE focuses on the critical transition from Foundation to Intermediate phase (i.e. Grade 3 and 4). It runs as a professional community of practice, which has met on a regular basis over the past five years. NICLE is constituted by the SANCP team of researchers, occasional invited education 'experts' (local, national and international) and about 40 regularly participating teachers, principals

and district officials who engage each year in workshops interrogating and implementing research informed ideas for strengthening primary mathematics teaching and learning in their schools. Workshop activities focus on ways to remediate and enable learner progression from predominantly concrete forms of calculation that tend to dominate the local primary landscape (Hoadley, 2012; Schollar, 2008). SANCP team members bring up to date research based resources for teaching and remediating mathematics learning to the community while teachers contribute critical classroom teaching experiences and knowledge of learners. Sessions promote increasing classroom participation and connectionist teaching (Askew, Brown, Rhodes, Johnson & William, 1997) in ways that foreground sense-making rather than ritual participation (Heyd-Metzuyanim & Graven, 2015).

In the second year of NICLE (i.e. 2012) teachers were increasingly willing to share their ideas, methods and opinions and some NICLE teachers chose to further their studies. Thus there is some overlap between the research community of practice (COP) within SANCP and the NICLE COP and several teachers have taken the lead in running sessions or aspects of sessions. We developed the 'agreement' with teachers that receiving any resource comes with the commitment of trying it in one's class and providing feedback in subsequent sessions on this experience. This worked well to increase teacher input and enables us to gauge the 'take-up' of workshop ideas. A key development in the NICLE program in 2012 was the introduction of the homework drive.

This drive provides teachers with homework resource materials for all Grade 2, 3 and 4 learners (and is based on teachers' commitment to use them for homework purposes). The design principles for each of the homework books are that: activities are relatively easy to access with simple instructions/ language accompanied by examples (they should not need mediation); activities are progressive and structured to encourage development of increasingly efficient strategies; activities encourage practice of 'basic facts' (Askew, 2012); across activities there is connection between concepts through the use of multiple representations such as number lines, hundred charts and so forth, and finally, learners are encouraged to make up problems of their own to solve enabling learner extension and some meta-analysis of question/activity types. The homework books are workbooks with place for working. Workbooks are printed for learners in English, Afrikaans and isi-Xhosa and are provided to teachers in the languages required by their learners.

Teachers get the next set of homework books for their class once a sample of their learners' completed homework books are shown to our project administrator. The reason for requesting only a sample of complete learner books related to initial teacher comments that they did not give homework because not *all* children did all their homework. We agreed that rather than not give any homework as a result it was important to allow learners who were willing to work hard and put in the steady independent effort required by homework the opportunity to do so. I shared my experience of providing homework books to learners in the first Grade 3 maths club I ran and that the majority of learners relished the opportunity to do regular homework. Half of the learners in this club completed the 48 page books I gave them in the first week even though I only suggested they do one page a day. Thus while it was important to encourage all students to do their homework I emphasised that we did not expect 100% learner compliance. Additionally we expected learners to work through the books at differential paces and indeed this was an advantage as it is often difficult to enable differential working in whole class

activities. However if a learner wanted the next book they would have to show their teacher that they had completed the previous homework book.

All Grade 2, 3 and 4 NICLE teachers participated in the homework drive in 2012 and 2013 and all provided samples of learner books, as required in order to receive the next set of books. The homework drive continues to date. While we acknowledge that there is not 100% buy in from learners in terms of always doing their homework, all Grade 2-4 teachers in NICLE in 2012 and 2013 were using the books for the allocation of at least some of the homework given to learners. At the end of 2012 and 2013, as part of the end year NICLE questionnaire, teachers were asked to provide feedback on their experiences of the homework drive. The responses of the Grade 2-4 NICLE teachers on these questions provide the empirical data informing this paper.

Research frame and methodology

SANCP draws on socio-cultural and socio-constructivist perspectives of learning for both research and development. Wenger's (1998) community of practice perspective of learning informs both the design of NICLE and the workshop activities. Also research into the nature of teacher learning within NICLE draws on this perspective (see for example Pausigere & Graven, 2014). Within this perspective, learning involves four central interconnected and mutually defining components of learning namely: meaning (learning as experience); identity (learning as becoming); community (learning as belonging) and practice (learning by doing).

Focusing on the nature of mathematics learning and how learners develop mathematical proficiency the project draws primarily on a socio-constructivist perspective. Thus learning mathematical concepts requires learners to actively construct and build concepts on existing knowledge. The hierarchical nature of mathematics requires that learners progressively develop this knowledge through interaction with a range of learning resources including peers and more knowledgeable others. In respect to the latter a willingness to engage with others in mathematical communication is important and this relates to the importance of developing a productive disposition.

Our project team has researched the nature of teacher and student learning, across the five years of the project (2011-2015) through collecting a wide range of quantitative and qualitative data in partner schools. These include our own annual mathematics learner assessments and a mathematics learning disposition questionnaire across all grade 3 and 4 learners in 11 schools (an average of approximately 1200 learners per year). Additionally teacher questionnaires, interviews and classroom observations have been conducted across the 5-year period.

Teacher questionnaires are given annually to teachers, which gather data on teacher experiences of their participation in NICLE and the various intervention projects attached to SANCP. Teachers participating in NICLE come from a range of project schools in the broader Grahamstown area and include a farm school, ex House of Representatives (HoR) schools, township schools and ex model C (formerly White only) schools. Data, and published research, points to many successes in terms of increased teacher confidence and commitment to practices that foreground sense-making and conceptual understanding, as well as data that shows overall improved learner performance on a range of assessments from 2011 to 2014 (SANCP, 2015; Graven, in press). However, here the focus is only on one aspect of the NICLE project – namely teacher experiences of the homework drive. Thus I

draw on teacher comments on the homework drive in the annual (end year) NICLE questionnaires of 2012 (end of the first year it was introduced mid year) and 2013 (the end of the second year in which it ran for a full year). The empirical data shared is thus the written teacher responses of the Grade 2, 3 and 4 teachers on the homework drive in the NICLE 2011 and 2012 questionnaires. NICLE provides the empirical field for this research into teacher experiences of the homework drive and as such the sample of teachers is an opportunity sample.

The homework drive and books focused on Grade 2-4 foundational mathematics concepts as they were deemed too difficult for Grade 1 learners and too easy for Grade 5-6 learners although some of these teachers did use the books for extension or remediation for some learners. In 2013, 23 of the 35 NICLE teachers were Grade 2, 3, or 4 teachers. Due to some changes in teachers in participating schools only 21 of the 23 Grade 2-4 teachers participated in NICLE in both 2012 and 2013. This paper thus reports on the written responses of those 21 Grade 2, 3 and 4 teachers who participated in NICLE across 2012 and 2013. All Grade 2 - 4 NICLE teachers elected to participate in the homework drive. These 21 teachers come from 8 different schools including from three township schools (7 teachers) and four ex HOR schools (13 teachers) and one ex model C school (1 teacher). Two teachers taught Grade 2, 13 taught Grade 3 and 6 taught Grade 4.

The questions relating to the homework drive project in the annual questionnaires were stated as follows:

> Do you give homework to learners? Say whether this is seldom, often or always.
>
> What are your experiences of the homework drive? Have you found it useful and to what extent have learners completed homework regularly?

The questions were phrased in the same way in 2012 and 2013. In 2012, 23 of the 44 NICLE participants were Grade 2, 3 or 4 teachers and thus had the opportunity to participate in the homework drive.

Thematic analysis was conducted on teacher responses reported in the findings below.

Findings and discussion

The first question simply enquired as to whether teachers gave homework and, if so, the regularity of it. All teachers answered ‘Yes’ to the question in both 2012 and 2013. In terms of the regularity of this in 2012 one third (7/21) said often while almost two thirds (12/21) said always. One teacher did not state the frequency and simply answered yes. Similar responses were evident in 2013 where one third said often and almost two thirds said always while two teachers did not state the frequency but instead wrote:

> Yes. It improves their mathematical skills, children enjoy homework – especially NICLE homework books! Children make their own homework, they love it.
>
> Yes. The homework drive has done so much for us. The different levels at which the activities has been set is so helpful.

The issue of enjoyment of homework by learners was similarly noted in several teacher responses who said they gave homework always because learners enjoyed it. Of interest this differs from the extent to which NICLE teachers said they gave homework at the start of NICLE (i.e. March 2011) – one fifth of these teachers indicated that they either did not give homework or only gave homework sometimes and several cited reasons of learners not doing homework and or problems with parents ranging from parents being unable to support homework or parents doing the homework for learners (SANCP, Indicator Report 2015).

The questions that focused on teacher experiences of the homework drive, included:

What are your experiences of the homework drive? Have you found it useful and to what extent have learners completed homework regularly? Despite the limitations of gathering data in questionnaire format, analysis of teacher responses gave rise to several interesting themes as to the aspects teachers valued in this homework drive and their experiences of it. The absence of certain themes, that I might have expected given my own motivation for the homework drive, was similarly of interest.

Following a thematic analysis of all twenty teachers' responses across the two years the following themes emerged:

Learner enjoyment

Six of the 21 teachers in 2012 commented on how children enjoy, love or are excited by the homework drive. For example:

> They loved the homework book but did not want to only complete the given pages. Therefore I have allowed those to complete as many pages as they want to.
>
> Learners enjoyed homework activities as a result they were asking for more activities.
>
> Learners were excited and some completed the books on their own before they were told to.

The above points to homework providing some learners with increased agency to go beyond what is merely requested of them. Allowing these learners opportunities to extend themselves and practice more than is required by teachers is an important aspect of enabling learners' ownership and independence in relation to their afterschool learning.

Steady effort (or regularity of work)

While a key part of the rationale for introducing the homework drive was to develop 'habits' of working regularly and independently on mathematics this aspect was only noted by two teachers in the 2012 responses. For example one teacher wrote:

> The drive supported learners to do their homework regularly.

Supporting mathematical learning (practice and strategies)

In the 2012 responses only one teacher comment related to the value of homework in terms of enabling learners to practice maths (which relates to the above category) while another commented on the value for improving calculation strategies:

> It is useful because they are getting a lot of practice.
>
> Their confidence improved a lot and their calculation strategies too.

Learner confidence

In 2012 two teachers commented that homework supported the development of learner's' mathematical confidence (as seen in the quote above). The second teacher noted:

> And learners feel so proud that nobody is helping at home-homeworks it improves their confidence

Comments in relation to parent support or absence of it

Several (4) teacher comments related positively to parental support for the homework drive. For example:

> And it has also brought the parents and children closer to complete their homework
>
> Parents were more aware of learners' progress

Balancing these comments on the positive aspects of parental involvement were four negative comments relating to the challenges of parental involvement and/or often the lack of it.

> It is only 2-3 learners who don't do homework because they don't have parents at home to support them.
>
> One problem is that parents are not able to guide homework, because some of them are working hard and others are not literate (most of them).
>
> I found that more often learners don't do homework because of lack of help at home.
>
> Sometimes parents write homework themselves instead of helping their learners and as an educator you have to educate parents first about the importance of homework.

The latter comment is important and points to the importance of teacher parent meetings in order to strengthen such initiatives.

Several teachers simply wrote that the homework drive was useful because learners did their homework. Such responses while indicating acknowledgement of the usefulness did not provide information as to why teachers find homework useful.

Similarly to 2013, the greatest frequency of teacher comments on homework was on the theme of learner enjoyment (7/21 teachers) and again there were several comments about learners being eager

to go beyond the prescribed amount. Other themes discussed above similarly emerged in the 2013 (i.e. at the end of the second year of the homework drive). For example relating to the *mathematical* value of homework *per se* one teacher wrote:

> The homework book is used as a baseline tool. It helps secure basic knowledge and skill for Grade4.

Of interest, while there were again positive comments about parental involvement the negative comments seen in 2012 about issues with parental involvement were no longer present. Some teachers who had stated problems with parents shifted their views. For example one teacher who wrote about the need to educate parents about homework (quoted above) now wrote:

> Even parents can participate by helping their learners with their homework.

The above indicates some shift from seeing parents as a possible obstacle to parents as a resource.

A new theme that emerged from one teacher related to the importance of learners working on their own and at their own pace. So for example she wrote:

> Good for learners to do homework on their own. Fast learners complete tasks quickly. Slow learners with the necessary encouragement are also able to do the homework.

Concluding remarks

While the buy in of teachers and learners in the homework drive is a positive finding it is useful to reflect on some of the reasons teachers give for this. Similarly it is useful to reflect on how these compare with my reasons for establishing the homework drive. The homework drive was established partly because I saw it as important that learners develop independent habits of steady effort and resilience in mathematics through doing homework (two key aspects of a productive disposition). Additionally homework should allow for the consolidation of essential foundational concepts and allow learners to work at differential paces. This would hopefully improve learner motivation; enable stronger mathematical confidence, increased enjoyment of mathematics (some homework activities were oral and dice games) and increased written participation in mathematics (an aspect noted as being low in primary classrooms as discussed in the introduction).

Of interest, the most frequently occurring theme in relation to teacher comments was how much learners enjoyed the homework. While ‘enjoyment’ or ‘love’ of mathematics is not a key aspect of Kilpatrick et al.’s (2001) definition of a productive disposition, it is emphasised as a key aspect of dispositions in SANCP work (discussed above) and has been emphasised in my research writing (e.g. Graven & Schafer, 2014). The notion of developing confidence was noted by some teachers too. Similarly, several teachers noted the issue of homework enabling consolidation, practice and different pacing for learners (and many teachers wrote how several learners went ahead of the homework given).

On the other hand one might have expected more comments as to the *mathematical* value of: developing foundational knowledge (and basic facts), progression towards increasingly efficient

calculation strategies and supporting connected understanding of multiple representations used in class (such as number lines and 100 charts). These were key design principles in the selection of activities and the way they were structured in the homework books (discussed above). Similarly one may have expected more comments relating to developing in learners the habit of steady effort and independent hard work (i.e. learning without the teacher), as this was a key motivation for the homework drive. However, only three teachers in their comments noted this.

Perhaps these absences are due to the limitations of the use of questionnaires and the way in which the questions were phrased. Interviewing may have yielded a wider range of findings and comments. On the other hand, it is interesting to note what teachers foreground and further research could explore the extent to which teachers' motivation for and experiences of homework change as learners move up the grades and from primary into high school. It is possible that in higher grades the emphasis on independence and a steady independent work ethic could be greater.

References

Adler, J. (2005). Mathematics for teaching: What is it and why is it important that we talk about it? *Pythagoras*, (62), 2–11.

Askew, M., Brown, M., Rhodes, V., Johnson, D., & William, D. (1997). *Effective teachers of numeracy*. London: London: King's College/TTA.

Bempechat, J. (2004) The motivational benefits of homework: A Social-Cognitive perspective. *Theory into Practice*. 43 (3), 189-196.

Corno, L. & Xu, Jianzhong (2004). Homework as the Job of Childhood. *Theory into Practice*. 43 (3), 227-233.

Fleisch, B. (2008). Primary education *in crisis: Why South African schoolchildren underachieve in reading and mathematics*. Johannesburg: Juta.

Carnoy, M., Chisholm, L., Addy, N., Arends, F., Baloyi, H., Irving, M., … Sorto, A. (2012). *The process of learning in South Africa. The quality of mathematics teaching in the North West Province. Technical report.* Pretoria: HSRC

Carnoy, M., & Arends, F. (2012). Explaining mathematics achievement gains in Botswana and South Africa. *Prospects*, *42*(4), 453–468.

Carr, M., & Claxton, G. (2002). Tracking the Development of Learning Dispositions. *Assessment in Education : Principles , Policy & Practice*, *9*(1), 9–37.

Department of Basic Education. (2011). *Curriculum and Assessment Poicy Statement Intermediate Phase Grades 4-6*. Department of Basic Education. doi:10.1787/9789264030206-4-en

Department of Basic Education. (2014). *Report on the Annual National Assessments 2014: Grades 1 to 6 & 9*. Pretoria.

Graven, M., Hewana, D., & Stott, D. (2013). The Evolution of an Instrument for Researching Young Mathematical Dispositions, *African Journal of Research in Mathematics , Science and Technology Education*, 37–41.

Graven, M., & Stott, D. (2012). Design issues for mathematics clubs for early grade learners. In D. Nampota & M. Kazima (Eds.), *Proceedings of the 20th Annual Meeting of the Southern African Association for Research in Mathematics, Science and Technology Education* (pp. 94–105). Lilongwe: University of Malawi.

Graven, M., & Heyd-Metzuyanim, E. (2014). Exploring the Limitations and Possibilities of Researching Mathematical Dispositions of Learners with low Literacy Levels. *Scientia in Educationе, 5*(1), 20–35.

Graven, M. (2014). Poverty, inequality and mathematics performance: the case of South Africa's post-apartheid context. *ZDM, 46*, 1039–1049.

Graven, M. & Schafer, M. (2014). A love of mathematical for playfulness as a key ingredient of Mathematics Knowledge for teaching. In M. Venkat, H. Rolnick, M.; Loughran, J.; Askew (Ed.), Exploring Mathematics and Science Teachers' Knowledge: Windows Into Teacher Thinking (pp. 163–178). London:NY: Routledge: Taylor & Frances.

Graven (forthcoming). Going back in order to go forward - recovery of mathematical foundations for intermediate phase improvement. *Journal of Educational Studies*.

Heyd-Metzuyanim, E. & Graven, M. (in press) Between People pleasing and mathematizing. *Educational Studies in Mathematics*. Available online 2015. DOI 10.1007/s10649-015-9637-8.

Hoadley, U. (2012). What do we know about teaching and learning in South African primary schools? Education as Change, 16(2), 187–202.

Khulisa (2015) End term evaluation report for the South African Numeracy Chair Project, Rhodes University 2011-2015. Khulisa: Jhb.

Kilpatrick, J., Swafford, J., & Findell, B. (2001). Adding It Up: Helping Children Learn Mathematics. Washington DC: National Academy Press.

Pausigere, P., & Graven, M. (2014). Learning metaphors and learning stories (stelos) of teachers participating in an in-service numeracy community of practice. Education as Change, 18(1), 33–46.

Reddy, V.; Zuze, T; Visser, M.; Winnaar, L. & Juan, A. (2015). TIMSSSA: Policy briefs Have we reached dender equity in mthematics education? Evidence from TIMSS SA 2011.

South African Numeracy Chair Project (SANCP) (2015) SANCP Indicator report. Grahamstown: SANCP, Rhodes University.

Schollar, E. (2008). Final report of the primary mathematics research project (2004-2007. Towards evidence-based

Spaull, N. (2013). Poverty & privilege: Primary school inequality in South Africa. International Journal of Educational Development, 33(5), 436–447.

Stott, D., & Graven, M. (2013). The dialectical relationship between theory and practice in the design of an after-school mathematics club. Pythagoras, 34(1), 10 pages.

Venkat, H., & Naidoo, D. (2012). Analyzing coherence for conceptual learning in a Grade 2 numeracy lesson. *Education as Change*, 16(1), 21–33.

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