BLENDING ELEMENTARY MATHEMATICS EDUCATION RESEARCH WITH DEVELOPMENT FOR EQUITY – AN ETHICAL IMPERATIVE ENABLING QUALITATIVELY RICHER WORK

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Abstract

South Africa, as a result of its apartheid history, is a nation of extreme socio-economic and educational inequality. Three aspects of this context are important in understanding why it is essential that educational research and development be intertwined. The first is South Africa's post-apartheid (1994) education context in which performance and opportunity gaps still persist along racial lines. The second is the in-service teacher education context, which – while aiming to support teachers in implementing three post-1994 cycles of curriculum revision – has attracted criticism for having failed to provide appropriate kinds of support, and thus, of largely alienating teachers. The third is the education research context, and particularly mathematics education research, which mostly tells deficit stories both of learner performance and of teacher practice. In relation to each of these contextual aspects, establishing non-exploitative and trusting partnerships with teachers and communities in which meaningful dialogue and joint investigation, informed by a range of stakeholder perspectives, is essential for navigating what might be possible within our current context of a stubbornly persistent education crisis. In this paper I briefly explain each of these aspects. I then share the design of the South African Numeracy Chair Project (SANCP). This project was set up to enable a powerful dialectical relationship between research and development through merging the two in a network that has created multiple opportunities for dialogue across stakeholders, dialogue that has focused on mutual learning towards addressing the challenges of elementary mathematics learning. While beyond the scope of this paper in the presentation I share the learning trajectories of three SANCP participants. I argue that establishing a network of development programs is not just an ethical 'nice to do give-back' to research participants. These partnerships enable access to data and stakeholder perspectives that would be inaccessible without the relationships developed in these spaces of collaboration, thereby strengthening the design of more appropriate research projects and leading to richer and more valid research findings. In these collaborative spaces dialogue and active participation among all participants is critical in the joint enterprise of finding sustainable ways forward to the educational challenges.

Keywords: Professional development, communities of practice, research for development, intervention projects

Introductory context

Under apartheid there were four racially segregated and differentially funded departments of education. The Department of Education for white citizens was well funded. The other departments were deliberately poorly funded. Education

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was used as a vehicle for maintaining white privilege. With South Africa's first democratic elections in 1994 there emerged a single education department and education became the vehicle for social transformation and redress of apartheid inequities. However, 23 years since the advent of our democracy educational inequality persists along both socio-economic and racial lines.

Participation in international and regional comparative research studies (such as Trends in International Mathematics and Science Study (TIMSS) and Southern and East African Consortium for Monitoring Educational Quality (SACMEQ)) tell a story of extreme failure of the post-apartheid aim that education should be the vehicle for redress of inequality. Our performance gaps of students in Mathematics and Science have been the highest of all countries participating in TIMSS (Reddy et al., 2015), and within the ten participating SACMEQ countries we have the highest between school performance inequality in mathematics (Taylor, 2009). South Africa has a bimodal education system: one system functions well and student performance in this system compares well to international benchmarks, while the other system, serving the vast majority of students, is largely dysfunctional resulting in among the lowest performance in TIMSS (Reddy et al., 2015).

While we may question the validity of international comparative studies we do not perform much better in regional studies (e.g. SACMEQ) where we are compared to countries with similar language challenges and economic disparities. Furthermore South Africa's own Department of Basic Education (DBE, 2014) Annual National Assessments (ANA) (begun in 2012 in Mathematics and Literacy from Grade 1 to 6 and Grade 9) show that in 2014 an average of only 3% of Grade 9 learners achieved 50% or more for mathematics. Of course there are many contributory factors (see Fleisch, 2008; Graven, 2014) including, for example, language of instruction practices that have 79% of Grade 4 students being taught mathematics in English while only 6.7% of learners are first language English speakers (Robertson and Graven, 2015).

A common response to reports on the data described above is teacher blaming (Shalem and Hoadley 2009; Graven 2012). The logic then is, if teachers are the cause of the crisis, then the system (Department of Basic Education) should provide in-service support in the form of increased specification for what teachers must teach (e.g. enforced weekly plans and learner completion of workbooks) and increase the monitoring of this. This not only deflects attention from broader systemic issues that need to be addressed but lowers teacher morale and shuts down the space for the kind of teacher development that could build on teacher experiences as a basis for finding ways forward.

Much teacher support has been in the form of short term, departmentally run 'workshops' in which teachers are provided documentation of what must be implemented. This seemingly ignores the data gathered in TIMSS, SACMEQ and

ANA that point to the need to address extreme backlogs in the mathematical knowledge of most learners which, Spaull and Kotze (2015) argue, is already 2 grades behind by Grade 4. In subsequent meetings or face-to-face school visits, teacher preparation files are inspected for compliance and curriculum coverage (Graven, 2016). Much needed support for developing teacher agency, to respond to local challenges of learners, is thus replaced with bureaucratically driven 'one size fits all' grade specific schemes of work.

Widespread research shows the dominance of concrete methods of calculation (i.e. tally lines) even for large number calculations well into the Intermediate Phase grades 4 to 6 (Schollar, 2008; Hoadley, 2012). Schollar (2008) found, for example, that just under 80% of Grade 5 children solve problems with unit counting and argued that "learners are routinely promoted from one grade to the next without having mastered the content and foundational competences of preceding grades, resulting in a large cognitive backlog that progressively inhibits the acquisition of more complex competencies" (p.1).

Forcing teachers to teach learners long multiplication of three digit by two digit numbers, when the children have not moved beyond tally counting results in teachers teaching long multiplication algorithms imitatively, often resulting in learner application of taught procedures without consideration of the reasonableness of the strategy or answer or the underlying place value of the digits being manipulated. So, for example learners taught the vertical addition algorithm, have been seen to answer 910 for 98 + 2 (Graven et al., 2013). In this dance of 'playing school' by learners, teachers, and departmental advisors mathematical learning appears to be completely out of focus. In a recent FLM paper (Graven, 2016) I shared the experiences of two teachers involved in one of our in-service teacher intervention projects. I wanted to illuminate how our current curriculum and systemic "support" work against teacher agency to respond to their local conditions and challenges. Here is what I wrote in respect of one of these teachers:

> Zandi was asked how she managed the tension of revisiting work from earlier grades and keeping up with the grade 4-7 departmental schemes of work. She responded as follows: We tell the subject advisor that I am actually at grade 2, CAPS [Curriculum and Assessment Policy Standards] says I must teach this [grade 4]. But my learners are not yet on that level. That means I have to go to grade 3 work. They [district advisors] said no it is wrong they know that some learners struggle or whatever but we are wrong to go back to grade 2, or grade 3. We always argue about that and then they will say it is from the top not from them and then what do you do? (pp.9-10).

Zandi's comments here illuminate the tensions that exist for teachers wanting to respond to the challenges they see in their classroom by deviating from the Department's "one size fits all" schemes of work. These schemes assume that the majority of learners entering each grade have mastered the curriculum of previous

grades, even while this flies in the face of the ANA results which are intended to inform teaching and learning. Teachers are thus placed in unenviable positions of being blamed for not fixing a crisis they are pushed to perpetuate. This highlights the need for the development of teacher agency in all project work through promoting dialogue among teachers, district and provincial departmental advisors and researchers and teacher educators (Long et al., 2017).

It also highlights the need for researchers to interrogate their responsibility in relation to the crisis context they are researching in and to question the role their research process and the research findings may play in helping to bring about improvements. As noted above much research, both under apartheid and since then, paints teachers in a bad light. While ethical requirements for education research are being tightened, many schools and teachers feel exploited by research that has offered no direct benefit in relation to their participation and that constantly reports on *their* deficiencies. Thus, even while anonymity is maintained, participation involves colluding in the construction of broadly damaging narratives that damage the status of their profession. Setati (2005) addressed this in a paper titled *Researching teaching and learning in school from "with" or "on" teachers to "with" and "on" teachers*, which I give as an introductory reading for SANCP researchers. The article pushes researchers to confront various ethical and political issues of researching teaching and learning in schools. Unidirectional power relationships between researchers and teachers, Setati argues, should be replaced with reciprocal relationships in which both teacher/s and researcher/s negotiate mutual benefits.

Indeed, when Professor Setati spearheaded the setting up of the private-government funded Mathematics/Numeracy Education Chair initiative in 2010 (of which I am the incumbent at South African Numeracy Chair at Rhodes University), she set them up as research *and* development Chairs, the first of their kind within the South African National Research Foundation's Research Chairs Initiative (SARCHI). In our Chairs, we were tasked with making a difference in the schools we work with through teacher development programs *and* researching ways forward to the many challenges we face in numeracy education. In other words, while we are asked to investigate the challenges, we need simultaneously to focus on possibilities within this context of challenge. We must *act for change* and not just state what is, or what should, be done. External monitoring and evaluation of the overall effectiveness of various programs implemented by SANCP has focused mainly on 'performance indicators' of the 'impact' of our work across the fourteen partner schools. (A positive evaluation led to renewal of a second 5-year term from 2016-2020). On the other hand, full time and part time doctoral students (over 20 students since the start in 2011) and SANCP team members mostly focused on smaller scale and more qualitative research that focused on a single programme or intervention with a small number of schools/teachers/learners (some with schools outside of SANCP partner schools)

in order to better understand the nature of learning enabled by specific interventions.

My view is that focusing on research that does not contribute to addressing the many challenges faced is a luxury we cannot afford in our context of extreme educational inequality, and is inconsiderate of the needs of teachers and learners who participate in our research. This view I found to be shared by the teachers in the Grahamstown area. Despite being a university town, with a long history of participation of local schools in university-based research studies, government school performance in the area continues to be low. Thus when I first approached primary schools and teachers to partner with SANCP in a professional development community which would meet regularly to jointly explore sustainable ways forward to the mathematics teaching and learning challenges they faced, teachers were understandably sceptical and reluctant. It was only after our first meeting where the few teachers who initially attended spread the word through their community networks that they came to believe that our project would *be different* from previous research or development projects that many teachers had joined. Soon our programme was over subscribed. This enthusiasm of teachers for finding ways to strengthen mathematics teaching and learning contrasts the oft heard deficit narrative of teachers reluctant to participate in professional development (PD). In my experience, teachers have shown overwhelming willingness and commitment to participation and engagement for improving teaching and learning when they experience meaningful opportunities to engage as respected professionals whose expertise is central to the engagement.

Having painted a picture of the context in which the South African Numeracy Chair Project (SANCP) emerges I now turn to discuss how SANCP responds to the above challenges.

The design of the South African Numeracy Chair Project (SANCP)

SANCP was set up as a 'hub of mathematical activity passion and innovation' focused on developing rich communication networks and spaces for collaboration and dialogue across all communities involved in mathematics education (teachers, parents, school management teams, district advisors, provincial curriculum planners, learners, national DBE mathematics/assessment specialists, local and international mathematics education professional and research associations) through projects grounded in the local needs of teachers, students, and communities.

The design of SANCP, and the long-term teacher development communities of practice (CoP) created within SANCP, was informed by Wenger's (1998) theory of learning in communities of practice which outlines four interrelated learning components. These are: practice (learning as doing), meaning (learning as experience), identity (learning as becoming), and community (learning as belonging). His work builds on his earlier work with Jean Lave in which they had

argued that learning is located in the process of co-participation and increased access of learners to participation, through which members develop changing ways of being and becoming. Here, access to quality resources is prioritized, and so, "to become a full member of a community of practice, requires access to a wide range of ongoing activity, old-timers, and other members of the community; and to information, resources, and opportunities for participation" (Lave and Wenger, 1991, p. 101). In this respect SANCP was based on the premise that teacher, student and researcher learning would be enabled through maximised access to participation in, and resources of various overlapping communities of practice. Wenger (1998, p. 214) defined communities of practice as "a living context that can give newcomers access to competence and also invite a personal experience of engagement by which to incorporate that competence into an identity of participation…and a good context to explore radically new insights". He argued furthermore, that:

> A history of mutual engagement around a joint enterprise is an ideal context for this kind of leading-edge learning, which requires a strong bond of communal competence along with a deep respect for the particularity of experience. When these conditions are in place, communities of practice are a privileged locus for the *creation* of knowledge (1998, p. 214).

The design of SANCP programs focused on establishing a partnership with teachers, students, school management teams, parents, and district advisors through setting up various platforms for regular engagement around mathematics teaching and learning. Two teacher development programs (the Numeracy Inquiry Community of Leader Educators (NICLE from 2011-2015) and the Early Number Fun programme (ENF from 2016-2017)), brought together Grade 2-5 and Grade R teachers respectively, as well as SANCP researchers and project staff, principals and deputy principals, and local/provincial departmental teacher advisors. Both programs foregrounded 'deep respect' for the teachers' particularity of experience, and drew on this as a critically important resource when engaging with 'new insights' on research-informed teaching methods and interventions. Together we would all search for sustainable solutions to mathematics education challenges.

Similarly, SANCP's after-school learner clubs were designed to break down traditional learner/ teacher relationships and learner dependence on imitation of taught procedures. Instead club activities foregrounded explorative talk and individual learner sense-making focused on discussion and development of a wide range of efficient strategies for calculating and problem solving and the development of number sense (see Graven, 2015). SANCP's family math forums brought caregivers and learners together on Saturday mornings in schools and community centres to work together on mathematics problems in a fun way. Thereafter a range of take home mathematics game resources, mostly using the

dice and cards given to families and oral games, were shared with some guidance on how caregivers might encourage children to more efficient ways of working while playing games. (So, for example, in a simple dice game where players must calculate the total of two dice, caregivers were encouraged to help children, through the regular playing of games, to move from *counting all* dots by touching each dot on the two dice (e.g. 6 and 3); to *subitising* (I see 6) and *counting on* from the largest number (6,7,8,9); to *knowing* the number bonds off by heart (6 + 3 = 9).)

Thus, the guiding principle for all SANCP work was that effective learning would require that all participants in SANCP projects actively share their experiences and knowledge with others in the spaces created for dialogue between members of different communities. These newly created spaces of regular engagement were especially powerful in that they generated opportunities for dialogue in non-traditional spaces where new forms of relationships could be built. In each of these spaces the projects endeavoured to build reciprocal learning relationships in which all are learners and participants.

Of course, the perceived hierarchies of status identities attached to positions of participants in various institutions - such as professor / researcher / teacher educator in a university; curriculum planner in the provincial Department of Education; or teacher / head of department/ principal in a school - cannot be wished away. However, by recognizing and conferring great value to teachers' experiences (in engagement between participants from different institutions – i.e. universities, district/provincial departments of education, and schools) *because* teachers are the ones who have the critical and grounded experience of working almost daily with learners in classrooms, teacher agency is enhanced in shaping the joint enterprises and practices of the PD CoP and, subsequently, the practices in their classrooms. The experiences of others in academia, research or district or provincial subject specialist positions provide a more global, but no more important, perspective in the joint enterprise of seeking solutions to the many challenges faced. As Wenger (1998, p. 149) notes, learning involves defining who we are "by negotiating local ways of belonging to broader constellations and of manifesting broader styles and discourses".

In this way, reciprocal learning is facilitated by working towards more equal power relationships that recognize that expertise lies in the experience each member brings in relation to their belonging to specific mathematics education communities, and that the learning for all in the PD CoP is maximized by dialogue and discussion between members belonging to overlapping communities. So, for example, in the NICLE PD programme teachers, researchers, teacher development academics, and government employed teacher advisors engaged around the common aim of finding ways to improve student mathematical learning. The more traditional relationships of teachers being at the receiving end of short-term information dissemination ('how to teach') workshops were

replaced with mutually respectful and beneficial reciprocal learning relationships. These relationships optimised participation and learning by members and became 'a privileged locus for the creation of knowledge' (Wenger, 1998, p. 214).

The diagram in Figure 1 (below) summarises the interrelationships between the various communities which SANCP has brought together through its three key projects (the PD CoPs (i.e. NICLE and ENF); the after-school math club programs; and the family math events). In these programs traditional bi-directional relations (i.e. between teacher educators and teachers in workshops or a monitoring meetings; between teachers and learners in classrooms; between learners and parents at home; between researchers and teachers in a data gathering situation) are opened up to multidirectional dialogue in which SANCP research and development members work to cultivate new forms of relationships in each of these project spaces focused on maximizing dialogue, participation and learning of all members in each community within each project space.

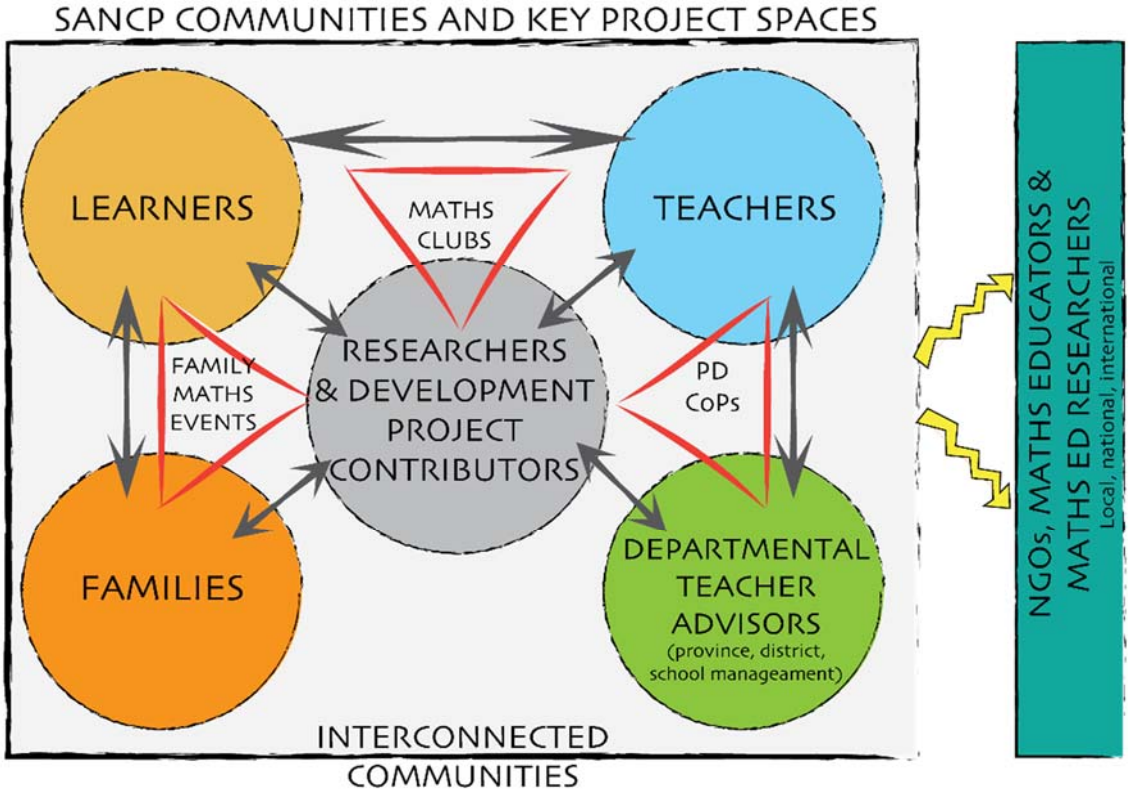

Figure 1: SANCP communities and key project spaces

While it is beyond the scope of this paper to describe each of these project spaces (but see Graven and Stott, 2015; Pausigere and Graven, 2014; Graven, 2015), suffice it to say here that these spaces continue to provide rich learning opportunities from which sustainable, locally trialled and tested interventions can be developed and researched, and then shared more broadly through our freely available website and through professional/research platforms such as conferences, stake-holder think tanks, or task teams and publication forums.

SANC Projects as research spaces

Figure 2 (below) captures SANC project researchers' participation in the three key research spaces.

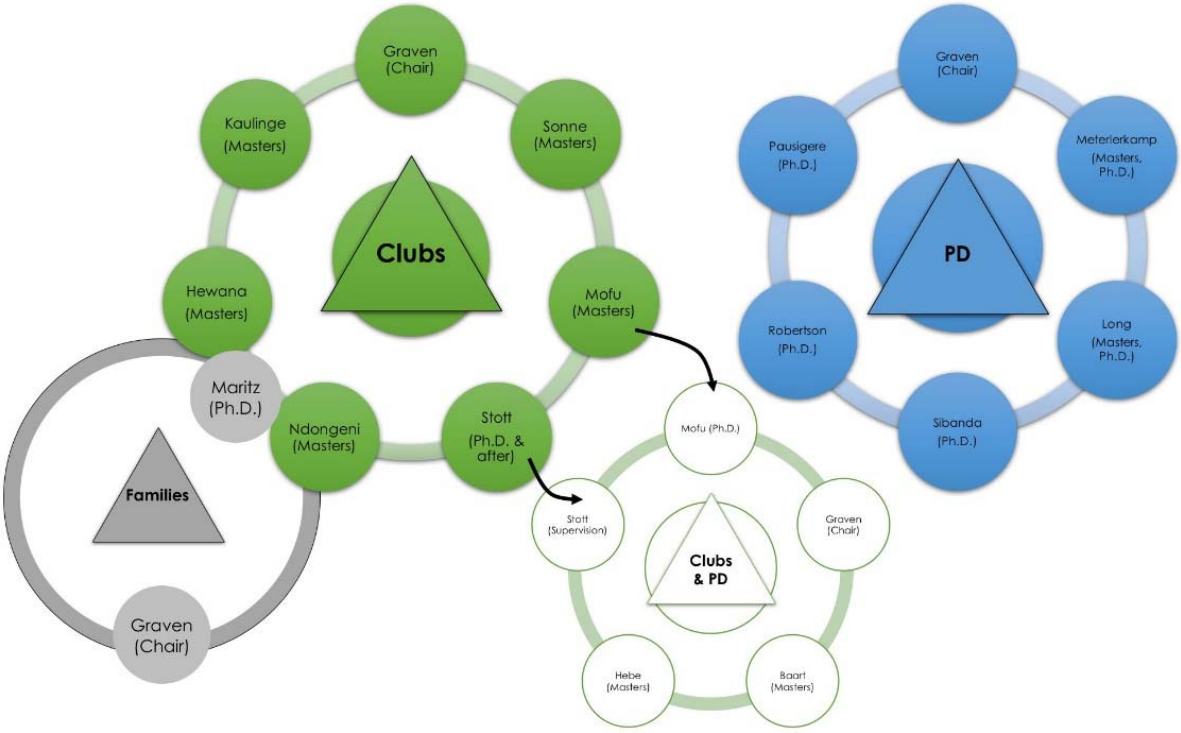

Figure 2: SANCP researchers and research spaces

By way of example, let me focus in on the mathematics club space and its triadic dialogue between *learners-teachers-R&D project contributors* (as shown in the top central triangle of Figure 1 and the two club triangles in Figure 2).

The mathematics after-school clubs were introduced in collaboration with teachers in order to provide: i) an after-school space for SANCP members to have direct grounded experience with local learners in partner schools; ii) a space for trialling research informed ideas before sharing them with teachers in PD CoPs more broadly; iii) supplementary support for the PD through direct learner interventions redressing learning gaps outside of the official curriculum. They were also designed to provide teachers a safe space to trial new ideas and more explorative ways of teaching, free from curriculum coverage demands, with a smaller group rather than a whole class of learners. Feedback from teachers over time indicated that club learners often became catalysts in their mathematics classrooms for modelling and demonstrating productive mathematical learning dispositions along with ways of talking and explaining their mathematical thinking (Graven, 2015). These club learners sometimes became the teachers' helpers in class.

I argue that this rich network of development work not only serves as an ethical 'give-back' to those participating in the research through responding to local

needs and challenges, but also enables more grounded and richer research that would not be possible without access to these networks and the relationships established across the communities of stakeholders in the various project spaces. With the growth of our SANCP research team of masters and doctoral students the mini laboratory developmental aspect of clubs provided useful after-school spaces which both enabled researchers to meet their obligation to 'give something back' to participating research schools *and* provided an empirical field for conducting research interventions aimed at finding sustainable ways forward to key challenges identified. So for example three researchers investigated the implementation of aspects of Bob Wright and colleagues' mathematics recovery (MR) programme in the after-school club context. In this way the club spaces enabled research to proceed without interfering with 'the normal school day' which the Eastern Cape Department of Education insists should not be disrupted in any way by research. These research projects and their findings then fed back into the NICLE PD through presentations made by the researchers, some of whom happened to also be NICLE teachers and departmental teacher advisors (in the presentation I will share exemplar stories to illustrate this).

Dissemination of research findings across the various after-school mathematics club interventions led to many requests for broader expansion of the after-school club model from NGOs and departmental teacher advisors and teachers from other districts and provinces. This then led us to develop a consolidated ten-week teacher development programme for club facilitators (coordinated by our graduated doctoral student and now full time SANCP research and development officer coordinating all mathematics club programs Dr Debbie Stott). This programme is now running in several provinces but of note is that three of our Masters and Doctoral students, who are also departmentally employed district/ provincial teacher advisors, are running these programs with teachers in three districts outside of the broader Grahamstown area. The two masters' students, Nolunthu Baart and Gasanakaletso Hebe, are focusing their research on *student learning*, while doctoral student, Zanele Mofu is focusing her research on *teacher learning,* each in the context of the ten clubs run by ten teachers with whom they have partnered in relation to their departmental supporting of teachers in their districts. One student is researching across family *and* club intervention spaces. Her research focuses on stakeholder experiences of the introduction of these and other educational interventions in four after care centres in the Grahamstown area. These centres cater for at risk children in various communities by providing them with meals and safe spaces to be cared for in the afternoons.

For other researchers, participating alongside teachers in the PD programs enabled trusting relationships to develop that led to teachers' willingly participating in student research studies and willingly allowing researchers to enter their personal classroom spaces for data gathering. For example: doctoral students, Peter Pausigere and Roxanne Long researched the nature of teacher learning within

NICLE and ENF respectively, while doctoral student Sally-Ann Robertson researched two NICLE teachers' classroom talk practices. In the presentation I will share three exemplar research-development trajectories to illuminate the powerful dialectic argued in this paper is created by a rich network of interconnected communities.

Concluding remarks

In this paper I have argued that establishing non-exploitative and trusting partnerships with teachers and communities is essential for navigating the way forward in the current South African education crisis. I have explained the way in which the South African Numeracy Chair Project (SANCP) was set up to enable a powerful dialectical relationship between research and development in a network of projects that create multiple opportunities for dialogue across stakeholders. What I hope to illuminate in the presentation, through exemplar trajectories of three members is the way in which the rich network of opportunities enabled participation in various roles *across* the multiple overlapping communities and projects, and that this provides momentum for increasingly central participation within each of these communities and a deepening of learning, stimulated by both grounded forms of belonging to the local practices of teaching, and participation in research and development work informed by a more global perspective.

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FROM CONTENT TO MEANING: SEMANTICS OF TEACHING IN THE TRADITION OF BILDUNG-CENTRED DIDACTICS

Tomáš Janík ☜

Abstract

The paper highlights images of the "new" culture of learning (evolving in the age of accountability) and argue that the focus on content is nowadays rather neglected in the school practice and in research on teaching. It presents the process of *emptying the content* as the great challenge of the "new" culture of learning. In an attempt to respond, the paper will turn to the tradition of *Bildung-centred didactics*. It will highlight the *semantics of teaching* and outline the theoretical background for the *content-focused approach* to (research on) teaching and learning that we develop and employ at Masaryk

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