

Confronting, Navigating and Resolving Research Tensions

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In this paper I share experiences from my recent three-year doctoral research journey specifically with regard to tensions that I encountered. I share how a pilot club at the same time influenced the design of the subsequent research study but also brought to light a number of theoretical and methodological tensions. I discuss how and why the research questions necessitated a dual focus on mathematical learning using the complementary lenses of acquisition and participation and illuminate methodological issues that arose from working with the questions. A key contribution of this paper is the focus on the dual nature of the study and how this was resolved both theoretically and methodologically. The tensions I encountered during the course of my research tell a story of my own learning process and they highlight reflective ‘praxis’ as a powerful part of the research process.

Introduction

Working from a broad Vygotskian perspective of learning and development, my research had a dual focus and investigated how Grade 3 learners’ mathematical proficiency progressed (or not) whilst participating in after school maths clubs over the course of a year, and explored how the mediation offered in the clubs enabled or constrained the emergence of zones of proximal development (ZPD) and thus learning for the club learners.

This paper points to experiences from a pilot club and the influence this pilot had on the subsequent design of the research study, specifically with regard to the questions and the data collection methods / instruments. I share how and why the research questions caused this dual focus to occur and illuminate some of the methodological issues that arose from working with the questions. A key contribution of this paper is the focus on the dual nature of the study and how this was resolved both theoretically and methodologically.

Context of the study and empirical field

As a member of the SANC project, I have the unique opportunity to participate in a number of maths clubs as both club mentor and as a researcher. Furthermore, I am the Maths Club co-ordinator and have been specifically tasked with the design and related facilitator training of the Maths Club programme for the SANC project. My work within the SANC project is focussed on both development and research in the field of numeracy.

In development terms the SANC project aims to improve the quality of teaching of in-service teachers at primary level and to improve learner performance in primary schools as a result of quality teaching and learning. The research remit is to grow an area of research which looks towards finding sustainable solutions to the many numeracy education challenges faced in our area. As part of the developmental work, the SANC project began in 2011 and has worked with 14 schools in the greater Grahamstown area, Eastern Cape, South Africa. The teacher development programme has worked with approximately 45 numeracy teachers (ranging from Grade 0 to 6) since the project started. These teachers have participated in regular workshops focused on issues and challenges in numeracy teaching.

In our project schools, we work with teachers and directly with learners. Learner activities are a key part of the SANC project developmental activities. We facilitate the development of learner mathematical proficiency by running learner-directed and learner-oriented mathematics activities as well as creating an ethos of ‘mathematics is fun’ in schools. Many teachers find themselves faced with the challenge that most of their learners do not have the necessary mathematical foundations to be learning at the grade level in which they are placed. As a possible way to address some of these challenges, the SANC project implemented after school mathematics clubs as a more focussed and regular learner intervention (Graven, 2011b, 2012). Within the SANC project, the clubs serve two purposes: firstly, they are a place where we can directly influence what happens with learners and secondly, they provide us with an empirical research field in which we can interact directly with the learners and thus be insiders to the learning process.

The empirical field for my research was two such after school maths clubs run within two of the SANC project schools. The after school clubs were conceptualised as informal learning spaces focused on developing a supportive learning community where learners can develop their mathematical proficiency, make sense of their mathematics and where they could engage and actively participate in mathematical activities. Individual, pair and small group interactions with mentors were the dominant practices with few whole class interactions. . The clubs were intentionally designed to contrast some of the more formal aspects observed in the classrooms of the SANC project participating schools (Graven & Stott, 2012; Graven, 2011a). Of note is that some of the intended practices promoted in the clubs are those learner-centred practices promoted in the official curriculum documents (Department of Basic Education, 2011) and which Hoadley (2012) notes are absent in South African classrooms.

In the latter half of 2011, Graven and myself piloted a maths club in a local school. Guided by the practices we wished to promote in the clubs we went into the pilot club with a grounded approach and open minds as to how we would structure the club and it’s activities. The pilot club influenced the subsequent research study in three key ways. Firstly, it influenced the design of the two case study clubs (the empirical field) used for my research study. Secondly, it influenced the re-framing of research questions and hence the subsequent data collection and finally it revealed the ZPD as an analytic tool for the subsequent research study. This paper focuses on the dual nature of the study as reflected in the research questions and on the methodological tensions arising from the changes made to the research design and methodology. The issues regarding the nature and design of the SANC project clubs following the pilot have been elaborated elsewhere (see Graven & Stott, 2012; Stott & Graven, 2013b).

Working within an interpretive research paradigm, following the pilot, this longitudinal case study research aimed to explore the mathematical proficiency of learners in two clubs and to examine the nature of the mediation evident in the clubs. Specifically the research questions were:

1. How do learners’ mathematical proficiency levels evolve (if at all) over the period of participation in the maths club?
2. What is the nature of the mediation that enables or constrains the emergence of a ZPD in the club learners?

At first glance these two questions seem to be in conflict with each other. The next section of the paper illuminates how I navigated the dual nature of these questions.

Navigating the dual nature of the research study

This study took a Vygotskian perspective to development and learning. According to John-Steiner and Mahn (1996) Vygotsky conceptualised development as the transformation of socially shared activities into internalised processes in his “general genetic law of cultural development” arguing that “higher mental functioning appears first on the “intermental” and then on the “intramental” plane” (Wertsch & Kazak, 2005, p. 3).

Every function in the child’s cultural development appears twice: first, on the social level [intermental], and later, on the individual level [intramental]; first, between people ... and then inside the child. This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher [mental] functions originate as actual relations between human individuals” (Vygotsky, 1978, p.57).

According to Daniels (2008) this general genetic law of cultural development “introduces the notion of some form of relationship between something which is defined as ‘social’ and something which is defined as ‘individual’” (p. 12) and this raised some important methodological questions for my study, which I address later. For example, there is some debate with regards to the how the individual is seen from a methodological point of view (see Sawyer, 2002 for example). Is the individual separable from the context or environment or must the individual be studied within the situated practice?

Additionally, Holzman (1997) argued that “to Vygotsky, learning / instruction and development are a dialectical unity in which learning leads development” (p. 57). This unity of learning/instruction-leading-development develops as a whole. Learning cannot exist without development and development cannot exist without learning (Holzman, 1997). Levykh (2008) argued that this dialectical approach “stands in opposition to the mainstream Western educational views that are mainly grounded in somewhat ‘linear’ Piagetian thinking” (p. 89). In other words, the process of development is not a direct and natural process, but rather “indirect, artificial, mediated (governed) by cultural laws of teaching-learning and, in contrast to Piaget proceeds not toward socialisation, but toward converting social relations into mental functions” (Levykh, 2008, p. 89). Vygotsky described the dialectical nature of learning and development thus:

learning awakens a variety of internal-development processes that are able to operate only when the child is interacting with people in his environment and in cooperation with his peers. ... learning is not development; however, properly organised learning results in mental development and sets in motion a variety of developmental processes that would be impossible apart from learning. Thus learning is a necessary and universal aspect of the process of developing culturally organised, specifically human, psychological functions (Vygotsky, 1978, p. 90).

These characteristics of learning and development highlighted key aspects for my study. Learning cannot exist without development and development cannot exist without learning. The “process of development is indirect and mediated by cultural laws of teaching-learning” (Levykh, 2008, p. 89) since learning and development are interlinked in this way for this study. As a researcher I needed to investigate how the learners in my study interacted with people in their environment and how mediation took place to encourage learning.

Sfard’s (1998) much-cited article on the two metaphors of learning identified and described the differences between two metaphors for learning. ‘Learning as acquisition’ implies that learning is the acquisition of something that is then stored in the individual. Learning as acquisition theories can be regarded broadly as mentalist in their orientation, with the

emphasis on the individual building up cognitive structures (Sfard, 1998). In contrast, the ‘learning as participation’ metaphor considers learning as a process of becoming a member of a certain community, which entails the “ability to communicate in the language of this community and act according to its particular norms” (Sfard, 1998, p. 6).

While some educators argue for the need for a paradigm shift away from (or even rejection of) acquisition perspectives in favour of participation, Sfard (1998) argued that these metaphors are not alternatives but that each provides different insights into the nature of learning. Hence, she argued:

an adequate combination of the acquisition and participation metaphors would bring to the fore the advantages of each of them, while keeping their respective drawbacks at bay. Conversely, giving full exclusivity to one conceptual framework would be hazardous (p. 11).

In my study, I purposely worked with both these perspectives using a complementary approach to the notions of acquisition and participation by drawing on Sfard’s ‘metaphorical mappings’ (1998, p.7). In later work, Sfard (2001) draws our attention to the idea that the participationist researcher will focus on the growth of mutual understanding and coordination between the learner and the rest of the community and the focus will turn to the activity itself and to its changing, interactional aspects. This was an important consideration for my study, as I explored how learners’ mathematical proficiencies evolved in relation to their participation in the maths clubs and the nature of the interactions with a focus on mediation, in the context of mathematical club activities.

Often these two perspectives are seen as being in opposition to each other. However, working within the broad sociocultural paradigm I describe here, the tensions between the two notions of acquisition and participation are nothing unusual. In my study I saw the two notions as forming a yin/yang type of fit, which complemented rather than conflicted with each other.

This complementary approach was a key part of my research study and was reflected and interwoven into all aspects of it. The two main research questions reflected the complementarity between the perspectives of acquisition (primary perspective foregrounded for question one) and participation (primary perspective foregrounded for question two) and as a result, so then did the methodology, findings, analysis and discussion of these questions.

Methodological concerns with this dual approach

With these complementary perspectives in mind and the idea that Vygotsky stressed the need to not concentrate only on the product of development but on the process of change (1978), both of these ideas influenced how I subsequently designed the data collection and chose the data collection instrument for the study.

Thus, question one foregrounded the acquisition perspective and looked at the measurement of possible learning for each club learner. The data collection instruments used in this study allowed me to measure this possible learning using diagnostic and formative methods. The data yielded individual data for each learner and was a mixture of both qualitative and quantitative data. Question two on the other hand foregrounded the participationist view and I collected video data that helped me to observe the process of how this learning was facilitated. This data was qualitative as I focussed on the activities and interactional aspects of learning in the context of the two clubs. This dual nature of the data collection instruments is shown diagrammatically in Figure 1. The left side of the diagram indicates the

acquisitionist aspects of the data collection whilst the right side reflects the participationist perspective.

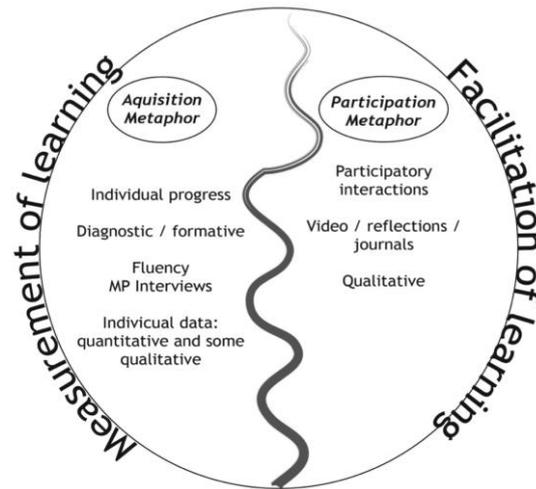


Figure 14. Dual nature of data collection instruments for this study

Smagorinsky (1995) argues that when sociocultural researchers conduct research on developmental processes, they “become part of that setting and thus become mediating factors” (p. 201) in the learning they are hoping to research. He argues that this does not ‘contaminate’ the research environment; rather the researcher becomes an “additional mediational means in a learner's development”. He continues to say that even the selection of the type of assessment means that the researcher enters the learning environment with “assumptions that a particular means of assessment is capable of determining learning” (p. 203). Thus he argues that within the Vygotskian perspective of development, the instruments of data elicitation are mediational rather than neutral. He elucidated thus:

to assume that the study of learning can take place outside the bubble of the social environment of learning is to misconceptualize the role of mediation in human development and to underestimate the effects of the introduction of any research tools into the learning environment (p.204).

Additionally, Smagorinsky argued (1995) that if the socially constructed data is to count as evidence for making claims in research, then there is a relationship between the assumptions about the optimal end point of development and the assumptions about the data that serve as evidence of progress towards that point. Therefore any assessment instrument “embodies the researcher’s sense of an appropriate developmental path for people to follow, and produces data that identifies people’s progress ... according to the direction of the path” (p. 200). In other words, the research process produces culturally shaped evidence of development towards a specific end point.

This insight about assessment instruments was important for this study. As the researcher, I chose to use the Learning Framework in Number (LFIN) (Wright, Martland, Stafford, & Stanger, 2006; Wright, 2003, 2013) to represent the developmental path of mathematical proficiency for the learners in my research study to address the first research question. In addition, I used an instrument which embodied the concepts of the LFIN to collect data on the club learners’ progress. Similarly, for question two, I used a data collection method (task-based interviews) that highlighted the importance of talk and dialogue between participants.

Thus the interview instrument was introduced into the learning environment and was mediational in nature.

Navigating the changing nature of research instruments

The timely administration of diagnostic assessment tasks in the pilot club enabled a powerful data-driven approach to activity selection to emerge from the club. The assessment instrument I drew on for the pilot club was the Askew, Brown, Rhodes et al. (1997) instrument which was orally administered to the club learners. Learners recorded their answers on individual scripts. However, I struggled with a way to track learners on-going progress in mathematical proficiency with the instrument as it stood. I was able to see if a learner had answered a question correctly but was unable to see *how* they had answered the question and whether the methods they were using to arrive at an answer were efficient. Following this tension, I decided to draw on tools from Wright, Martland, Stafford and Stanger's (2006) Maths Recovery programme for data collection and analysis for the subsequent research. I used the one-to-one interview as a data collection instrument and the Learning Framework in Number (LFIN) as an analysis framework for the subsequent case study clubs. These interviews took place out of club time by arrangement with the club learners' teachers. This interview and the LFIN enabled me to administer detailed one-to-one interviews with club learners, to note how they arrived at various answers, profiling learners at particular stages / levels in the LFIN and allowed me to track detailed progression over time and thereby provide data for my first research question.

Navigating ethical tensions with learner assessments

Once ethical permission had been gained from the university, Eastern Cape Department of Education, the schools and parents, the collection of data via one-to-one interviews was straightforward. However this was not the case with a second set of instruments I used to track learner progress in the clubs.

In the pilot, Graven and I introduced a series of timed fluency activities to encourage learner fluency in basic facts (drawing on Askew's (2012) basic facts). Initially, these activities were intended to simply be part of the mental maths warm-up activities promoted. However we realised that they provided useful research data for monitoring learner progression. A clear advantage of these fluency activities was that they were fast and took roughly six minutes to administer, giving us quick access to learners' fluency levels in the basic facts. I thus decided to give them to my case study club learners in 2012 on a more regular basis as a way of supplementing data collection and for quick evaluation of learners' progress. While these assessments in this form were useful, an ethical tension arose for me as timed activities are by design time pressured and thus can be stress inducing for learners. A review of literature reveals a sizable body of work that puts forward an argument against timed activities in mathematics (see for example Boaler, 2012; Burns, 2007; Gilliland, 2001). In our work within the SANC project we have noted that any kind of assessment can produce anxiety in learners, not just timed test. I have reported on the structure and effectiveness of these fluency activities and have addressed the ethical concerns elsewhere (Stott & Graven, 2013a).

Navigating the challenge of collecting and transcribing data in authentic contexts

For my second research question I planned to use video as the data collection method and I originally intended to collect video data in every club session, which I attempted to do in the first half of 2012. However, as the data collection period continued, this approach proved to be challenging. It transpired that I was collecting a lot of data but it was not particularly useful.

Looking at the early video data collected, I realised that it would not be suitable for analysis purposes. The first obstacle was that as the club mentor I could not collect video data at the same time as being a participant in the club. On realising this, I asked a number of colleagues to assist me in recording video data during club sessions. However, upon viewing the data recorded in this way, I encountered a key obstacle: lack of focus on learners faces, gestures, speech, activities or events of any significant duration. There were numerous reasons for this. Many of my club sessions took place on the carpet, thus much video showed tops of heads and little else. Additionally, learners in the clubs often spoke softly and with the background noise of other learners, I could not make out from the video what was said. Also, learners were highly mobile making videoing difficult. I realised that this video provided data with regard to the structure of club sessions, the socio-mathematical norms we were promoting and the pace of the sessions in the clubs (Research journal entry, 3 July 2012) but did not provide data that zoomed into the mediation or emergence of ZPDs. This was a central problem for my research given my second research question was focused on mediation.

To find a way forward, I selected a number of video excerpts from this early data set and shared them with Prof Lerman⁸. We discussed the issues I had encountered and he agreed that another approach would be necessary. I talked this problem through with my supervisor and after some preliminary reading on task-based interviews, I decided that I would use task-based interviews as a data gathering tool to collect focussed and data rich video data for the second research question with pairs of learners in a noise free environment. Task-based interviews are generally designed so that the interviewees not only interact with the interviewer and with each other but also with a task that is carefully designed for the purposes of the interview (Maher & Sigley, 2013). Maher and Sigley (2013) highlight that a carefully constructed task is a key component of the task-based interview. They further suggest that as the interviewees are engaged in mathematical activity, the researcher is able to observe their actions and record them with video recordings. In my case, one mentor facilitated the interview and another recorded the video. These recordings, along with transcripts of the recordings, interviewees work and post interview reflections provided the data for analysis of the second research question.

I had some concerns that these task-based interviews were contrived as learning situations, but Prof Steve Lerman pointed out that all learning situations in formal classrooms are ultimately contrived. When conducting the interviews, I emphasised to the learners that these interviews were similar to being in the club environment and that during the interview, we would participate and interact the same way as we did during normal club sessions (I often worked with pairs of learners and moved from one pair to another). The only difference was that it was quieter and there were only two learners at a time, so we were able to record their discussions. I also carried out the interviews in the same venues used for the clubs, in order to add to the learners' comfort levels. The following extract from a transcript with two girls participating in the task-based interview illustrates how I introduced the interview:

Can I just explain what we're doing? Alright. You know I try and video the club sometimes and I find it really hard because I have to run around with all the groups and they're all doing different things and also I can't hear properly what's going on.

⁸ I worked with Prof Lerman at the SAARMSTE research school in June 2012 on my video data and we had a discussion about how I was to resolve the issues I was having with collecting video data.

So what we decided to do is we've done a little mini club with the boys and we're going to do a little mini club with you two. Okay? So that we can hear and we can see and get some proper video because the stuff that I do in the club normally doesn't work very well.

All right, so all the club things that we know, about talking to each other, arguing with each other, giving your opinion, trying, working together. All those things that we do in the club. I want you to pretend this is just a club, but it's just the two of you. (Transcript of task-based interview video recording, 19th October 2012)

The main focus of the task-based interviews was to facilitate the learners in undertaking various carefully selected tasks with the aim of eliciting learner talk and thus providing data which focused on the nature of mediation in the clubs and how this may enable or constrain the emergence and sustainment of ZPDs in club learners. More specifically I used the video data to examine how interview participants caught each other's attention and the overall nature of mediation used by the mentors.

Navigating the issue of playing multiple roles in the research process

As mentioned, I play multiple roles in the SANC project: those of researcher, club facilitator and club coordinator. I thus wore multiple hats during the research study. At the start of the research process it was possible that these multiple roles could have caused tension. To that end I used my reflective journal to document as much about how the roles impacted on each other and on the process of research.

Throughout my research study I kept a detailed research journal. Following the pilot, this became a significant data collection tool. Through the course of my study I made a point of writing in the journal frequently and it became a habit to do so after weekly club sessions, after reading literature, after working on data, after supervisory sessions, when grappling with a theoretical or methodological tension, when writing research papers and conference presentations and so on. I also used the journal to sketch the many diagrams I used in my study as these diagrams helped me to make sense of many aspects of my work. The entries were invaluable when it came to remembering the stories, the personal learning process, decisions I made and why and how aspects of the research evolved. Ultimately the entries enabled a reflexive praxis to emerge during my study.

For me 'praxis' is a way of doing things or a way of translating theoretical ideas into action. This gave me a new way of looking at my roles and how those roles interacted with each other. For Graven (2004), the dual role gave her a number of advantages: it enabled a form of action-reflection practice, gave form to her research and the process, the on-going reflection was stimulated by her research and her own learning was maximised by the on-going reflection. These insights encouraged me to be aware of how multiple roles might bring a powerful praxis to my research project. By being aware of these insights before I started this research, I was able to make the most of the opportunities presented by these differing and challenging roles.

Smagorinsky (1995) argues that from a Vygotskian perspective, data generated through the research process is a social construct developed through the relationship of the researcher, research participants, the research context and the methods of data collection. He further points out that researchers need to reflect on how their involvement in the research process affects teaching, learning, and the evaluation of both. Drawing on these comments, I argue that in my case, the relationship between the researcher and the research context (the clubs within the SANC project) was a highly complex one. Nonetheless it was one that allowed me to reflect not only on how the research process affected teaching and learning in the clubs but

also on how the research process affected me as researcher and the context in which I operate. In the following paragraphs I illustrate how my triple role enabled an on-going, powerful reflexive practice to develop between the club learning programme design, mentoring in clubs and my research with reference to Figure 2, which illustrates this triple role diagrammatically.

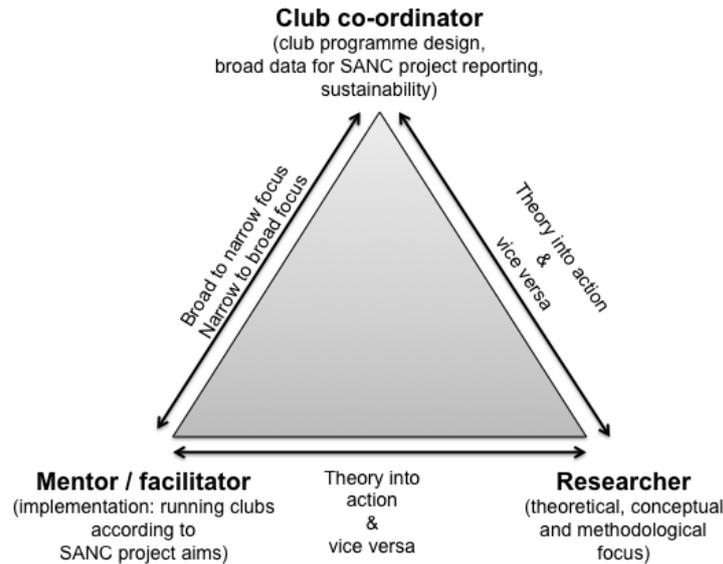


Figure 15. Diagrammatic representation of my triple role in maths clubs

In my role as club co-ordinator and club programme designer, I had the opportunity to translate a theoretical or methodological idea from the research literature into action. It is not within the scope of this paper to detail more than one example, therefore I briefly provide an example where all three roles influenced each other. Mellony Graven’s and my experiences in the pilot brought to light the entwined and dialectical nature of the data collection and design processes and the significance of the post-club reflection sessions as a powerful data collection instrument for planning the club sessions. Furthermore, through the pilot we identified and shaped the zone of proximal development for the purposes of our club as the critical design concept for each club session for each learner. In addition, the pilot influenced the broader study leading to an increased focus in my research questions and thus the theoretical and conceptual frameworks and the methodological design. This reflective praxis illuminates the relationships between theory and practice and how the dialogue between the two elements informs each. We used empirical evidence to move from an initial multifaceted design to a much simpler, more learner-centred design and these findings informed the data collection process and the club session design for the subsequent research study.

Concluding remarks

My motivation for sharing these experiences was to illuminate that the path of undertaking a research study is not straightforward and without tensions and issues. Educational research takes place in real world contexts, with real people. Issues that arise have to be confronted, navigated and resolved and I believe that the process of sharing how this is done in a research context is an important aspect of academic citizenship. The tensions I encountered during the course of my research tell a story of my own learning process and they highlight reflective ‘praxis’ as a powerful part of the process.

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Acknowledgement

The work of the SA Numeracy Chair, Rhodes University is supported by the FirstRand Foundation (with the RMB), Anglo American Chairman's fund, the Department of Science and Technology and the National Research Foundation. I thank the Chair, Mellony Graven, who was also my supervisor, for her guidance with regard to my research and this paper Prof Steve Lerman for informative and productive conversations about Vygotsky's work and my video data.