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Research for educational change: Transforming researchers' insights into improvement in mathematics teaching and learning

INTRODUCTION

How can educational research fulfill its commitment to educational practice? This time-honored question is the one that gave rise to this book. The more specific query of how to bridge research and practice in conditions of poverty and inequality became its main focus. Within the context of mathematics education, this single, all-encompassing problem can be decomposed into three separate issues, each of which is serious enough to keep researchers awake at night. First, how can one *explain* the lingering, pervasive failure in mathematics experienced by so many students around the world, but especially by those who live in conditions of scarcity and social injustice? Whatever answer is given to this first question, the next issue is how can one transform the resulting understanding into educative action? In particular, how can we *interpret* instructional practice and then design intervention aiming at its *improvement*? (Krainer & Goffree, 1999). The third issue is one that has come to the fore more recently: how do we enable the impact of such interventions and how do we make sure that local improvements or reforms are scaled-up (e.g. Cobb & Smith, 2008) and sustained (e.g. [Kieran, Krainer, & Shaughnessy, 2013](#)).

All these are long standing questions which, in spite of their being constantly discussed and generally recognized as critically important, do not seem to be any less puzzling today than they were decades ago. Whereas nobody seems to doubt that research-generated insights can have beneficial effects on learning and teaching of mathematics, the question of how these effects are to be generated and sustained is far from evident. We were well aware of all of this while making the decision to have our own take of the issue. It thus did not come as a surprise that our ensuing efforts were obstructed by worries, doubts and dilemmas. From time to time, some of these problems appeared serious enough to prompt thoughts about discontinuing the project.

Our first, quite obvious worry was that it might simply be impossible to succeed in the endeavor in which most attempts so far have been only partially successful, if at all. We have been mindful of the relentless persistence of the achievement gap, that is, of "... the observed disparity in ... academic performance between different groups of students, especially groups defined by race/ethnicity, gender and socioeconomic status... especially in mathematics and science" (Clark, 2014a p. 3). The achievement gap is an international phenomenon, one that can be seen almost everywhere in the world, across national contexts. In Australia, for instance, the inequality of mathematics learners' educational outcomes persists in spite of the five decades of intensive research on the subject. Indeed, as shown by Jorgensen & Lowrie (2015) poor performance in mathematics is as inequitably distributed there and as tightly

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correlated with socio-economic circumstance as it has ever been. Similar things can be said about countries as diverse as the USA, UK, China and Mexico (Clark, 2014b). These examples made us doubt the chances for our own success.

If we finally regained the faith in our project, this was because of our decision to take a path quite different from those pursued in the majority of research-to-practice studies, so far. Many such projects have come in the form of meta-analyses or of general deliberations (e.g. [Kieran et al, 2013](#); see also the ICME10 Survey Team Study titled *Relations between research and practice in mathematics education*, as summarized in Sfard, 2005). We decided that rather than attempting a comprehensive, possibly large scale research at the end of which we would try to outline a general plan for reforming practice, we would act in the way best described by Graven: we will

explore issues of disempowerment and agency, constraints and possibilities and the complex interplay of factors that create ... widely established national statistics, while simultaneously *defying them in particular local contexts*. Such research could shift the focus from a discourse of deficit and helplessness towards a discourse of possibilities in the struggle for equity and quality education for all. (Graven, 2014 p. 1039, emphasis added)

The idea of doing research *in a particular local context* was taken seriously in the five-year long research-and-development project in South Africa that gave rise to this book. That project, called *The Wits Maths Connect Secondary* (WMCS), was conceived as a response to the growing concern about the actual role of research in countering the legacy of apartheid and in fighting its impact on teaching and learning of mathematics in South African schools. More detail of this comprehensive undertaking is presented in Chapter 2. Here, let us only outline its main idea. The focus of the project is on specific classes in specific schools and on day-to-day, classroom activities. The researchers and teachers collaborate with each other on a regular basis. In this down-to-earth, concrete way, the participants try to make a difference by proposing specific changes in specific practices rather than by offering general principles that lend themselves only too easily to misinterpretations and misuses. This project is thus quite special in at least two respects. First, the task of translating research into practice is actually *performed* here, not just discussed. Second, being done in South Africa, the country whose education system is now widely recognized as failing the majority of the learners, this project tackles the question of how to turn research into a lever for practice *in the context of learning and teaching hindered by poverty, oppression and social injustice*. Since this book can be seen as a miniature reflection of the whole project, these two characteristics are also clearly visible in the story told along its pages.

It is the nature of this latter, collectively told story that brought our other worries and dilemmas. Let us thus dwell for a moment on the contents of our narrative and on the way it was constructed. The origins of the book go back to the symposium organized as a part of WMCS project in 2012 with the participation of most of the authors. The

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event was titled *Doing mathematics discourse research: and translating it into constructive feedback to the teacher* and the way it was structured reflected the guiding principle of the WMCS project: research done in a school had to benefit this school with an improvement in the ways the teachers taught and with a simultaneous raise in the learners' achievement. In concert with this idea, the participants of the symposium were charged with a double task of, first, investigating a portion of data collected in one classroom and second, proposing the way their insights could be communicated to wider audiences and utilized by teachers in their further practice. The data were composed of two parts: (1) video-recordings and transcriptions of a lesson on the topic of quadratic inequalities taught by the teacher whom we call here Mr T to a grade 11 class in a school located in a Johannesburg township, and (2) interviews with two pairs of learners held two months after the lesson and evolving around its topic. For the analyses, each participant of the symposium chose her own theoretical approach and her own questions. Later, each presenter produced her distinctive "interface" materials through which the insights gained in the analyses were communicated to those for whom they were produced in the first place: the teachers and, in at least one case, the general public.

Already in the preparation for the symposium and then during the proceedings we realized we may experience difficulty, both moral and political, disseminating the classroom story generated through the quadruple analyses. Whatever aspect of Mr T's activity was considered – whether it was the mathematics he modeled for his students, the way he orchestrated classroom communication or the opportunities for learning he created by doing so, the findings were uniformly unsatisfactory and saddening. Although we found Mr T well-meaning, hard-working, committed to his students and highly likeable, we deemed his instructional practices as wanting, and in more than one respect. We started to wonder about the way we could possibly tell this story and, at a certain point, we began asking ourselves whether we should publish it at all. What will be the consequences of making unsatisfactory practices public? For whom will the repercussions be most serious? What stereotypes of poverty, inequality and educational practice are we going to reinforce in this way? Above all, are we really prepared to present a narrative that is only too likely to be read as an indictment of the teacher? On the other hand, how could we outline our focal problem without being sincere about its nature, its concrete manifestations, and its worrying dimensions?

For some time, we believed that the solution of the dilemma could lie in the choice of words in which we were going to describe what we saw. Soon, however, we realized that whatever words we use, the resulting picture could be read as following a "deficit model" and as an attempt to put the blame on the teacher. To forestall such criticism, therefore, let us explain already now that none of these applies to the analyzes presented in this book. True, we do criticize what is happening in the classroom, and we do not wish to disown these critical descriptions. And yet, the term "deficit model" was coined to denote the cognitivist research in which researchers looked

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only for what they thought should be there, and when they failed to find this, reported on what participants *did not* do rather than on what they actually did. In our analyses, however, we bring high-resolution portrayals of the participants' ways of acting, and only then subject them to critical analysis. Most importantly, the object of our criticism is neither the teacher nor any other individual; rather, our complaint is about the collectively constructed, historically established practice which is exemplified in this classroom simply because this is the only mathematics-teaching practice to which the teacher himself had ever an access. Thus, if there is talk about deficits here, it is about deficits of *social practice*, not of a *person*. Such practices and their problems must be brought to light if we are to act against the social forces that produce them. This, indeed, is the underlying assumption of the WMCS, in which improvement is attained incrementally in the iterative process of researching practice, modifying this practice and then researching the practice again. Improvement, of course, always begs the question of "towards what?" and so assumes some privileged direction. All the authors confront this issue when, following their analysis of the data, they construct their unique interventions.

The critical undertones of our story about Mr T brought yet another concern, one that became most acute when we were mulling over the question of how to communicate our insights to those about whom and for whom we wrote – teachers and other practitioners. The question was one of the mutual positioning. Our overall vision was not unlike the one promoted by Kieren et al. (2013) in their review of different ways in which various projects have tackled the research-practice gap: the practice will not change without a close collaboration between researchers and teachers. We saw both these communities as producers of knowledge about practice, with each of them having to offer something the other one could not attain on its own. This belief found its expression in the WMCS project, in which we tried to make the collaboration between researchers and teachers as balanced as possible. The question we have repeatedly asked ourselves was how to preserve this relative balance in a book in which one voice – that of the researcher – is given primacy, if not exclusivity. While this problem may have no easy solution, it is hopefully made less acute by the fact that the authors remain attentive to, and quite explicit about, the needs and relative strengths of their audience.

Our last concern had to do with the mathematical topic featured in our data, the quadratic inequality. One can question the wisdom of teaching this highly esoteric mathematical topic to young people who are likely to go through their lives without ever having to deal with this kind of mathematical problem. We resolved this difficulty by deciding that we take the curriculum as given and attend only to our focal issue of how to translate research findings into an improvement in teaching. Our rationale for this decision was that as of now, quadratic inequality must be taught by almost any high-school teacher to almost any high-school learner around the world. For the learner, not being able to meet the expectations means lesser chance for

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further success and a greater risk of exclusion. Mindful of the fact that our first job was to support mathematics teachers and the learners, we decided that this is what we had to do irrespective of our objections toward dominant educational practices. Indeed, such objections could not possibly release us from our commitment to the project of making teaching of the required mathematics as good and effective as possible.

Having described the concerns and dilemmas with which we have struggled in our project, let us now outline the contents of the resulting book. The first of the four parts of which this volume is composed sets the scene for the whole project. Mindful of the deep inter-relation between education, culture and socio-economic conditions (e.g. Alexander, 2000) we recognized the need for placing the practices we were about to describe in their wider socio-cultural context. The context was indispensable if we were to interpret our data cogently, be able to justify them, and make them understandable to others. Chapter 1 brings a panoramic view of education in contemporary South Africa, whereas Chapter 2 describes the setting of the lesson around which the following analyses evolve: the school in which this lesson was taught, the teacher who taught it and the curriculum of which it was a part.

The focus of the second part is on research and its findings. A single corpus of data composed of transcripts of the lesson and of two follow-up interviews with the learners is analyzed and interpreted in a number of ways by four teams of researchers. While looking for their own interpretations of what was said and done, all the analysts address the same question: “What opportunities for learning mathematics did the teacher create in this classroom and what kind of learning did these opportunities evoke?” Each of the teams uses a different theoretical lens, and each of the answers that emerge from the analyses is stated and justified in a slightly different language. Reporting the findings, therefore, involves communicating between different research discourses.

The third part is where the translation from research to practice takes place. Here, each of the four teams of researchers turns to teachers, curriculum designers, professional developers or concerned newspaper readers and proposes practical actions that may bring answers to the needs this team identified in its analyses. The four chapters differ in their addressees, as well as in content and form of the suggested activities. Each of them constitutes an innovative exercise in bridging discourses of two institutionally distinct communities, that of academia and that of practitioner.

The cross-discursive conversation is advanced even further in the fourth part of the book, where four commentators bring in their own perspectives on the problem to which this volume is devoted. These authors also try to arrive at a synergetic effect by

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comparing and contrasting the various proposals across chapters and discourses, and where possible, by pulling the different threads together.

We could not conclude this introduction without saying a few words about the interests we tried to address in this volume and about the book's intended audience. Two discourses are presented here: that of researchers speaking to one another, and that of researchers communicating their insights to those responsible for, or simply concerned about, the educational practice. It seems therefore reasonable to hope that the book, whether in its entirety or in specific parts, will be of use to a wide range of educational agents – researchers, teachers, teacher-researchers, policy makers and curriculum developers. In addition, we expect that the South African context within which our focal issue is discussed will be of interest to an even wider audience. Located in a township in post-apartheid South Africa, the school we visited serves learners from poor communities. What we see here is representative of the majority of South African schools, and this may be true also of many other places in the world. This type of setting is still rather rare in mathematics education research, the main bulk of which has been done in more affluent environments (Skovsmose, 2011). This situation is now changing as research reports began emerging from places such as rural Australia (Jorgensen & Lowrie, 2014), or 'urban' schools in the US (Martin & Larnell, 2013). This book is another attempt at correcting the imbalance.

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