Crucial descriptions: Talking back to theory and practice in mathematics education through research[1]

Renuka Vithal, University of Durban-Westville, South Africa

In research, descriptions of practice are carefully produced by making selections from the data. This unavoidable selection is often made in such a way so that the description is tightly connected to the researcher's inention: to confirm or extend particular ideas, develop new ones, or to challenge and critique them. It is the last function - that of creating the possibility for critique and development of both practice and theory - that is of interest in this discussion. This opportunity must be provided, it is argued, particularly in a study that is exploring theory practice relations that integrate a critical perspective. In this paper I elaborate first, theory-practice relations and how crucial descriptions feature in that relation, and then its function in this research in terms of four key ideas: transparency, transformacy, exemplarity and generativity.

Introduction

A theoretical landscape I sketch and in which I position my research is one that draws together strands of ethnomathematics, critical mathematics education, concerns about gender, class and race and South Africa's own developments in people's mathematics (Vithal 2000). As a teacher educator I introduced student teachers to theoretical ideas in this landscape through what I refer to as a social, cultural, political approach to a mathematics curriculum, which integrates a critical perspective (Vithal 1997). My research focus was to see what happens when student teachers attempt to realise such ideas in a mathematics classroom. Although they were introduced to several activities related to these, in practice, they tried out project work during their teaching practice sessions (see Vithal et al 1997, Paras 1999). It is the production of a description of their educational practice and its functions in the research that is problematised in this paper.

Descriptions of educational practices abound in educational literature. But both the nature and content of the descriptions and the purposes for which they are produced vary quite considerably. Descriptions of educational practices may be used in teacher education courses, as indeed was the case in this study. Students teachers read descriptions of many different practices related to a critical mathematics education, ethnomathematics, etc. How descriptions are read and acted on offers a lens on how the relationship between theory and practice may be characterized. For some, theoretical ideas are taken as rhetoric or slogans about practice; for others they regulations, prescribing practice, to be followed like a recipe. Yet others see theory as offering guidelines for practice,

---

[1] This paper also appears in I. V. Mutimucuio (ed.) Promoting Regional Collaboration in Research in Mathematics, Science and Technology Education in Southern Africa. Proceedings of the 9th Conference of the Association for Research in Mathematics, Science and Technology Education. Maputo, 17-20 Jan, pp. 80-90.

P. Valero & O. Skovsmose (2002) (Eds.). Proceedings of the 3rd International MES Conference. Copenhagen: Centre for Research in Learning Mathematics, pp. 1-12.

illustrations of particular ideas, spaces for creativity and inspiration for new ideas. Descriptions of educational practices offer a tool for practitioners - teachers and teacher educators - to think and act within practice.

In research, descriptions are often tightly linked to the research question or focus and to particular theoretical positions that make it difficult to know anything more about a research situation other than that which supports the propositions the researcher is putting forward. Descriptions are couched in language and represent interpretations which are neither neutral nor 'objective'. By producing a description, the researcher reveals, implicitly or explicitly, the (theoretical) framework in which she is operating. The question is what sort of description of an educational practice is appropriate to a study that seeks to explore a theory-practice link in mathematics education, which integrates a critical perspective? How can a description open an opportunity for engaging in a critique of both the theoretical ideas which inspired the practice and the practice itself. One possibility is to attempt to create what may be referred to as a *crucial description*: "A description of an educational practice which makes it possible for an outsider to make a critique of a certain theoretical position in mathematics education" (Vithal and Skovsmose 1997: 150) and the practices associated with it. Such a description, it may be argued, serves to connect theory to practice on the one hand, and the theory-practice relation to research on the other.

They may be essential more specifically, because the reader relies on the researcher's eyes to look into the classroom., to any research that is undertaken from a critical perspective. An educational theory that makes critique a central feature must also attempt to realise this possibility in the descriptions of educational practices. The opportunity for critique needs to permeate the research as a central theme, in the research focus, its processes, relationships and outcomes. Critique is essential not only in the sense that the researcher is undertaking critique, but also in that another person, including research participants, can engage in a critique of the research, the underpinning theory and associated practices. In this way the description does not become dogmatic as theory or as practice. "A crucial description cannot be based on the intentions of an education perspective but must reveal what is actually happening when an attempt is made to realise this perspective in an educational setting" (Vithal and Skovsmose 1997: 151) - what could happen rather than what should happen. Who makes the description – the researcher or practitioner - and who is the primary audience for any description produced from a research situation has implications for the resonance of the descriptions with the experience of each given that each have different vested interests and criteria for evaluation.

In a study of the relation between theory and practice, it is the description that provides the means to examine the relation between a theory and related practices. The notion of a "thick" description is well established in qualitative research to refer to a detailed description. Crucial descriptions may be thought

of as special kinds of thick descriptions. But they may be distinguished from other descriptions in that they attempt to provide a more open or loosening of the theoretical framework in the study by allowing an outsider to somehow feel, see, and experience a classroom setting in which theoretical ideas are interpreted into practice, and from which new ideas are created and critiqued. Although the description will include the key terms in the theory, it should also give the reader (which may include the research participants), the possibility to critique the researcher's interpretation.

Crucial descriptions and theory-practice relations

The notion of crucial descriptions is, of course, underpinned by a particular understanding of the relation between theory and practice. No doubt, the assumptions that underpin how this relationship is understood, acted on and studied vary considerably. The production of theories, their relation to practice and their use in research may be separated but are related issues. What constitutes sources for theorising? The very term theory, according to Mason and Waywood (1996: 1055) is "value-laden ... Its roots are in the Greek meaning *seeing*, with derivatives such as *contemplation* and *speculation* as well as the mathematical term *theorem*" (emphasis in original). Theories are produced in particular contexts in response to particular concerns, questions and issues to provide universalisable explanations, hypothesis or possibilities, beliefs to guide action (see also Thomas 1997). Theories are said to be useful, even powerful when they help in a sense-making process, particularly in a wide variety of situations, and usually when offering novel insights. But what is its relation to practice? For Mason and Waywood (1996: 1056) "All senses of 'theory' are in part defined through contrast with practice. The dialectic between theory and practice reflects a tension between life as lived and life as understood and construed".

The debate about the relation between theory and practice is probably as old as mathematics education itself as the long standing topic area in ICME attests (see Christiansen and Verstappen 1988 - report of discussion from ICME 6). It seems possible to posit two extreme views on this relationship. In the one, theory (such as a critical mathematics education theory) and practice (such as project work) are seen as being in "systematic co-operation" and research could support such a co-operation (see Cooney in ibid. 1988). Theory is seen as being defined by, and directly connected to practice. It is inseparable from practice and there is a constant struggle to find some kind of logical, linear and systematic relation between the two. At the other end, theory is seen as separate from practice but not unconnected. Theory does not co-operate with practice but each appropriates, exploits and absorbs from the other (Verstappen in ibid.: 1988). "Theory is characterized by reflection, and practice by action. But theory cannot guide practice like a map …theory has no direct relation to reality or practice. Teachers use means such as techniques but not theory, which is a different kind

of activity. So theory has to be converted. Therefore you need continuously organised co-operation, but there are institutional and political barriers." (Otte in ibid. 1988: 385). It is this latter view that seems to be sustained and supported in mathematics education. In the ICME 7 report, Seeger (1994: 282) explains that theory and practice offer different but complementary lenses to view what goes on in classrooms. They "reflect upon and speak about the same processes and structures but with different voices, from different perspectives, using different modes of reflection. What is needed, then, in the co-operation between theory and practice, is a dialogue where the different voices are listening to each other". But what are the means for enabling such a dialogue? Could crucial descriptions have a role to play here?

Even though a two way process from theory to practice and practice to theory seems to be suggested, the overwhelming main concern is with the former of these directions, for instance with how to bring changes in practice by means of theory (see also Steinbring 1994). This process of "constructing a pedagogic discourse" as Bernstein (1996: 116) calls it, requires distinguishing "between three fields, each with their own rules of access, regulation, privilege and specialised interests: a field of *production* where new knowledge (a particular theoretical landscape) was constructed; a field of *reproduction* where pedagogic practice in schools occurred; and a field, in between, called, the *recontextualising field*. Activity in this (last) field consisted of appropriating discourses from the field of production (theory) and transforming them into pedagogic discourse (and practice)." (Italics in original, brackets added). The process of recontextualising involves principles of 'de-location' (a selective appropriation of a theory or parts of it) followed by principles of 're-location' (of what has been appropriated into the recontextualising field which may be reproduced as practice). "In this process of de- and re-location, the original discourse underwent ideological transformation according to the play of specialised interests among the various positions in the recontextualising field." (Bernstein 1996: 116). This means that what is selected as foci, its ordering, power relations, and so on in the one field are all transformed in the other (Dowling 1993: 83). This process may be rather ad hoc (Thomas 1997).

This implies then that theory and practice are fundamentally different in several aspects including the basis of their sources and goals. Theorising includes reflections from different sources, serves different purposes and is not disconnected from the theory writer's location, interests, experiences, knowledge, perspective and biography. Educational practice, on the other hand, takes on particular forms in response to certain theoretical ideas, but also as a result of changes in other imperatives such as resources, policies, school administration and organisational structures and so on. Therefore, instead of speaking of implementing or translating theory into practice, we should rather attempt to understand what occurs when theory and practice meet each other. One arena for this meeting is the context of classrooms. Even when this meeting

is explicitly arranged, practice takes on and re-organises aspects of theory in its domain, and theories change through their confrontation with the reality of classrooms, surviving in parts. Neither theory nor practice emerges unscathed through this encounter. What must be emphasized is that the theory-practice relation should not be biased toward understanding mainly the process by which theory impacts, shapes or becomes practice. Equally important is the impact practice can have on shaping theory. Crucial descriptions open this possibility for practice to speak to theory and as such is a source for theorising as well as for developing practice.

The journey that theories take have themselves been the subject of theorising – we see theories emerge, grow, interpreted, refined, disputed, survive in parts, and finally taken over by new theories. The questions of who produces theories, why some come to dominate in research and in practices, and what counts as theory must also be raised, since the answer lies not only in the content of the theories but in the politics of knowledge production and its distribution. Theories related to mathematics education, recontextualised into practice and used in research in South Africa, are dominated by those produced in the Western world. How theoretical understandings produced elsewhere are imported into research and practice is a complex process (Valero and Vithal 1999). But that this occurs makes it very important to find the means for practice to talk back to theory. Mathematics educators, practitioners and researchers, including myself, draw on theories produced elsewhere and interpret them for particular contexts. The theoretical ideas acquire different meanings in their new contexts and some selection also occurs as practitioners and researchers focus more on some ideas than others. Through their reflections, captured in crucial descriptions, researchers and practitioners can provide insights that critique and advance *both* the theories and their associated practices, making it possible to evaluate the appropriateness of particular ideas for particular situations. Developing a theoretical landscape for mathematics education in South African, and particularly one that integrates a critical perspective requires assessing which theoretical ideas are invariant across deeply diverse situations, which are not, and what new ideas would need to be created, that is the gaps and silences in theories and practices.

Crucial descriptions and research

To develop this notion of crucial description, I refers to a research journey from a theoretical hypothetical situation begun in a university lecture room to a school mathematics classroom where a research situation was arranged. A brief stay in this arranged 'curriculum laboratory' led to the production of a wide variety of data. These data, I am arguing, could be organised into what may be called a *crucial* educational case description. The crucialness of the description lies in its capacity to allow someone, other than the researcher, to take a look into the classroom in a manner that enables critique of the practices themselves, the

analysis and reflections which follow. The challenges posed for crucial descriptions of mathematics educational practices, which attempt to integrate a critical perspective, may be considered through its role and function in the research in terms of at least four key ideas: *transparency*; *transformacy*; *generativity*; and *exemplarity*.

Transparency

Crucial descriptions enable transparency. Transparency is required to meet the obligation in the research process to offer the opportunity for critique. Through transparency, crucial descriptions open a window to the battleground in which theory and practice confront each other in the classroom. The concept of transparency may be considered to have a dual function of visibility and invisibility (Lave and Wenger 1991; Adler 1998). Since crucial descriptions give access to and make visible the arranged classroom situation, the description of practice focuses on the practices. These can however, can point both backward to make available the existing theoretical landscape and forward to the emerging theory. The invisibility function allows the critical reader to look through the description of practices to see and enter a critique of the theoretical ideas. As a resource in the research endeavour for the researcher, the research participants and the reader, it makes visible the classroom practice and through the practice illuminates the theoretical ideas. But what is taken as visible and invisible depends in part on who is the reader and her vested interests in the description.

All descriptions, including crucial descriptions, simultaneously produce and rely on a 'language of description' (see Bernstein 1996) which make transparency possible. This refers to the dialectic of the empirical data and the theoretical work, enabling the researcher to identify what can be interpreted as data (called recognition rules) and how to interpret that data (realisation rules) (see Dowling 1993). No doubt a description is constituted through data, and Dowling explains that "Data can be understood as the product of the recognition and realisation rules of the language, but there will always be an excess in terms of possible interpretations." (ibid.: 88). The main concern for him is making the language as visible and as explicit as possible. What needs to also be questioned is how the language itself comes to be produced, and how this language is to be critiqued and transformed (see 3.2)? A crucial description attempts to both make visible and problematise the language of description. Because the researcher tells the story, she chooses and develops a particular language that reflects a particular (theoretical) perspective in the selection and interpretation of the data. A crucial description seeks to simultaneously 'weaken' this frame, in part, by allowing the language of the practitioner to be heard in the description. There may be a double framing of the description, from theory and from practice. A crucial description allows one to see through the language of description into the

context and to critique the practice. It also allows a reader to criticize and assess the language of description itself.

Through the function of transparency, crucial descriptions provide a tool for reflexivity - a key concept in theory, practice and research in mathematics education from a critical perspective. Through reflexivity, crucial descriptions enhance and support democratic participatory validity in the research (See Vithal 2000). Student teachers could dispute the analysis and the related concepts with evidence from the crucial description. As the researcher, the crucial description made it possible for me to also engage in a critique of what I was putting forward and assists in distancing me from the theoretical landscape that I am exploring through self reflexivity. Crucial descriptions have the potential to make transparent not only the processes in the research but also the positions and involvement of the different research participants. It is this transparency function of crucial descriptions that makes the description an object of critique but also tool for critique. By providing a wide angled lens on the "confrontation" between theory and practice, the researcher, research participants and those not with them in the classroom can have the opportunity to critique the theory and the practice, and thereby contest the description itself and also what emerges from it.

Transformacy

Transformacy refers to the potential crucial descriptions carry for transforming theory and practice through critique. Crucial descriptions, no doubt, assist in clarifying and illustrating theoretical and conceptual ideas, but they are concerned not so much with verifying these but rather with their evaluation, critique and development relative to particular practices (Nielsen and Simoni 1994). They may be contradicted, refined, extended, even excluded and equally may bring about changes in practice. The opportunities for transformacy are enhanced because crucial descriptions allow the reader to see the research situation more fully and holistically.

The transformacy function of crucial descriptions is especially important in contexts of theory and practice importation, which is widespread in countries like South Africa. The problem is that the descriptions of practice are tightly connected to the theoretical ideas, which do not offer much possibility to see outside the description. This applies both to those who produce theories and those who import and use theories. However good the intentions, and however thoughtfully the ideas are interpreted in practice, the need to develop descriptions that allow for outside critique is an important consideration in contexts like South Africa where the potential for challenge and development in theory and practice are enormous. Creating crucial descriptions that give access to the possibility of critique prevents a blind or detrimental importation and implementation. But equally important is that the transformacy function of descriptions suggests that theory importation may be desirable, even necessary

as a means for theory development and change, since aspects of a theory or conceptual ideas may be illuminated in a very different context, which may have remain hidden in the context in which the theory was first conceptualised. Such an assertion rests on an assumption of understanding theory as not only value-laden but also as 'context-laden'. Aspects of contexts, including values, get built into theories in ways which are difficult to locate, and dislocate once the theory exists. It is by looking at some other context through the lens of a particular theory that both another view of that context is created and an opportunity to re-examine the lens itself - a double transformation. Crucial descriptions are essential to this task.

The extent of a critique made possible by a crucial description could lead to modification and reorganization of a theory that is major or minor. Taken to its extreme, a description that opens for critique could lead to a 'refutation' of the theory as a whole. This is not a new idea as several approaches to this can be found in the philosophy of science. For instance in the work of Popper (1963) we note that for every theory there is a set of falsifiers. A theory must open for refutation or else the theory becomes dogmatism. Thus, theories exist to the extent that they can be criticised. The main point is that descriptions of educational practices must allow questioning of the very theories they seek to give meaning to. A crucial description, in this sense, could force you out of your theoretical framework.

The question this raises is to what extent do researchers get trapped in their chosen theories and frameworks. This seems almost inevitable since, according to Mason and Waywood, "To understand the role of theory in a research program is to understand what are taken to be the things that can be questioned and what counts as answers to that questioning" and once a theory is invoked "it entails an ontological commitment to the objects created in, by and for that theory" (1996: 1056). But we could argue that the commitment can (or must) surely include the possibility of rejecting or reforming those objects (or at least some of them) and the invention of new ones. In this sense theories are neither "once and for all", nor stable in research and in education. Constructing a crucial description in which a researcher refrains from a significant sanitisation of the data and hence of the description, assists in making the description less personalised and less self-supporting in the research. Transformacy includes a concern for how can the researcher avoid being trapped in her language of description. A crucial description enables *self-critique* - creating opportunities for the researcher to talk back to her presuppositions in the research. The transformacy function of crucial descriptions refers to both theory and practice, researchers and practitioners.

Generativity

Related to the transformacy function of crucial descriptions is its generative function. Although critique may be generative, an analytic separation may be

useful to see that while transformacy focuses on the critique of theory and practice, generativity emphasises that crucial descriptions can play a role in giving rise to new theoretical ideas and inspiring new forms of practice. Through critique, crucial descriptions not only have the possibility for theory and practice ideas to acquire new dimensions but could also lead to discarding of some aspects. Generativity as a criterion of quality offered in the methodology of a critical approach to research (see Vithal 2000) is realised through crucial descriptions. Generativity refers to a kind of grounded theorising. It can also bringing together existing ideas from a particular theoretical landscape and research methodology into new relationships and formations, as well as interpret existing ideas in new and different ways. Generativity linked to creativity refers equally to the development of practices alternative from what the crucial descriptions reveal.

Generativity may be especially important in South Africa because of the rapidly changing and disruptive nature of its educational setting. It has been argued that such situations have tremendous potential to generate new ideas in theory and practice (see Vithal 1998). In order to realise this potential, crucial descriptions not only allow critique of the existing ideas but also assist in identifying gaps and silences in the theory which may surface in through the instability and discontinuities in practice. Even where these may appear to be outside the framework of the research or theory, they may still be relevant to the educational setting and therefore essential in the theory. Critique here includes critique of absences or what may be rendered invisible through the very framework employed in the research situation. A crucial description of project work tells not only of its strengths and support in the theory and practice, but also points to difficulties and weaknesses in the practice and therefore equally to problems in the theory. Crucial descriptions are essential to help develop realizable alternatives in real classrooms and can contribute to the development and better understanding of existing practices. In this way new directions are opened for further ‘experimentation’ and for changes in practices in actual situations and also in the theoretical landscape.

Exemplarity

Exemplarity played a double role in this research, having a place in the educational theory (see Skovsmose 1994) as well as the research methodology (see Vithal 2000). Crucial descriptions need to serve an exemplarity function. A single crucial description of an education practice could allow us to reflect on, and understand the complex theoretical whole from which it arises and the educational system of which it is a part. A single crucial descriptions also enables the generation and understanding of a new theoretical or educational complexity. Exemplarity, like transparency, can move us both backward and forward from the pivot offered by a crucial description, into the existing theoretical totality that inspired the research, or toward a new complexity that

could arise from the research. By reading a crucial case description produced in one context, for example South Africa, a reader from another context who has never been to South Africa, could come to understand and reflect about the (mathematics) education system in South Africa, even as she comes to know and critique the theory. Through the exemplarity function a crucial description connects the complexity of a context with the complexity of a theory, making both visible and open for critique and transformacy.

Generativity has been coupled with exemplarity in the research methodology and theory. The bridge between generativity and generalisabilty, is constituted through the exemplarity function of crucial descriptions. A crucial description makes it possible for a reader to consider generalisation because of the extent and detail in the description. Through exemplarity, the crucial description enables us to know something about what could happen in the whole and therefore in other parts of the education system, and hence is generative of ideas.

Conclusion

What remains to be seen is to what extent the potential of crucial descriptions of education practices, so optimistically set out above, can be realised. So having argued for crucial descriptions, let me hasten to add that it is not immediately obvious exactly what the content of such a description is, nor exactly what the process for its construction entails. Although crucial descriptions should attempt at the very least “to reveal the nature of the interactions in the teaching-learning situation: the interaction between teacher and student and the interactions between students and the topic" Vithal and Skovsmose 1997: 151) and among students themselves, they need to also give the background and the social context against which a theory is being interpreted (Nielsen and Simoni 1994) and particular practices evaluated. They need to be broader in revealing also organisational structures and events in classrooms and schools and yet also detailed revealing the identities of teachers, learners and researchers themselves as they constitute any teaching-learning research situation. Although crucial descriptions themselves may take different forms of representation in research, their construction requires and relies on a wide range of data such as teacher and student journals, recordings of interactions, teacher and learner materials used and produced, assessment forms and frames and outside classroom and school information and engagements so that what is made available through any description is continually re-interpreted against a changing and diverse society.

References

Adler, J. (1996) Secondary School Teachers’ Knowledge of the Dynamics of Teaching and Learning Mathematics in Multilingual Classrooms. Doctoral Dissertation, University of Witwatersrand, South Africa.

Adler, J. (1998) ‘Resources as a verb: Recontextualising resources in and for school Mathematics’. In Olivier, A. and Newstead, K. (eds.) Proceedings of the 22nd

Conference of the International Group for the Psychology of Mathematics Education, Volume 1. Stellenbosch University, 12-17 July. (pp. 1-18)

Bernstein, B. (1996) Pedagogy, Symbolic Control and Identity: Theory, Research, Critique. London: Taylor & Francis.

Christiansen, B. and Verstappen, P. (1988) 'Topic Area 18: Systematic Cooperation Between Theory and Practice in Mathematics'. In Hirst, A. and Hirst, K. (eds.) Proceedings of the Sixth International Congress in Mathematics Education. Budapest: Malev. (pp. 382-388)

Dowling, P. (1993) A Language for the Sociological Description of Pedagogic Texts with Particular Reference to the Secondary School Mathematics Scheme SMP 11-16. Doctoral Dissertation, University of London, UK.

Lave, J. and Wenger, E. (1991) Situated Learning: Legitimate Peripheral Participation. Cambridge: Cambridge University Press.

Mason, J. and Waywood, A. (1996) 'The role of theory in mathematics education and research'. In Bishop, A. J.; Clements, K.; Keitel, C.; Kilpatrick, J.; Laborde, C. (eds.) International Handbook of Mathematics Education. Dordrecht: Kluwer Academic Publishers. (pp. 1055-1089)

Nielsen, L. and Simoni, S. (1994) The Spider's Web: Case Studies of the Relation between Theory and Practice. Masters Thesis, Department of Mathematics and Computer Science, Aalborg University, Denmark.

Paras, J. (1998) 'Improving the Playground: A Fence-Building Project in Mathematics.' Pythagoras, 46/47, pp. 57-62. (Also appeared in 1997 as Research Report No. 11, Dept. of Mathematics, Physics, Chemistry and Informatics. Royal Danish School of Educational Studies.)

Seeger, F. (1994) 'Topic Group 14: Cooperation Between Theory and Practice in Mathematics'. In Gaulin, C.; Hodgson, B. R.; Wheeler, D. H.; Egsgard, J. C. (eds.) Proceedings of the 7th International Congress in Mathematics Education. Sainte-Foy: Les Presses de L'Universite Laval. (pp.282-285)

Skovsmose, O. (1994) Toward a Critical Philosophy of Mathematics Education. , Dordrecht: Kluwer Academic Publishers.

Steinbring, H. (1994) 'Dialogue Between Theory and Practice in Mathematics Education'. In Biehler, R.; Scholz, R. W.; Straber, R.; and Winkelmann, B. (eds.) Didactics of Mathematics as a Scientific Discipline. Dordrecht: Kluwer Academic Publishers. (pp. 89-102)

Thomas, G. (1997) 'What's the use of theory'. Harvard Educational Review, 67(1), pp. 75-104.

Valero, P. and Vithal, R. (1999) 'Research methods of the "North" revisited from the "South"'. In Perspectives in Education, 18(3).

Vithal, R. (1997) 'Exploring Student Teachers Understanding of a Theoretical Perspective in Mathematics Teacher Education'. In Sanders, M. (ed.) Proceedings of the Fifth Annual Meeting of the Southern African Association of Mathematics and Science Education. University of Witwatersrand, January 23-27. (pp. 331-342)

Vithal, R. (1998) 'Data and Disruptions: The politics of doing mathematics education research in South Africa'. In Ogude, N. A. and Bohlmann, C. (eds.) Proceedings of the Sixth Annual Meeting of the Southern African Association for Research in Mathematics and Science Education. University of South Africa, 14-17 Jan. (pp. 475-481)

Vithal, R. (2000) In search of a pedagogy of conflict and dialogue for mathematics education. Doctoral dissertation, Aalborg University, Denmark.

Vithal, R.; Paras, J.; Desai, S.; Zuma, Z.; Samsukal, A.; Ramdass, R.; and Gcashbe; J. (1997) ‘Student teachers doing project work in primary mathematics classrooms’. In Kelsall, P. and de Villiers, M. (eds.) Proceedings of the Third National Congress of the Association for Mathematics Educators of South Africa. University of Natal Durban, July 7 - 11. (pp. 261-276)

Vithal, R. and Skovsmose, O. (1997) ‘The End of Innocence: A Critique of ‘Ethnomathematics’. Educational Studies in Mathematics. 34, pp. 131-157.