DISCUSSION FORUM
WHAT IS RESEARCH IN MA THEMA TICS EDUCATION?

Panel: Richard Noss, Institute of Education, London John
Mason, Open University
Barbara Jaworski, University of Oxford
Critical responder: Steve Lerman, South Bank University Chair:
Laurinda Brown, University of Bristol

Richard Noss, John Mason and Barbara Jaworski were invited to address this issue in not more than fifteen minutes each with a brief to share their particular methodologies and give a sense of the range of problems which might be appropriate for the use of such methodologies. The discussion was then open for comments from the floor after which Steve Lerman gave a critical summary to close the session. What follows are the inputs from the panel in terms of what they chose to share by overhead transparency on the day and a post hoc reworked critical summary from Steve Lerman.

Some personal notes on research **in** mathematics education - Richard Noss

Preface: In writing these notes as 'theses', I run the risk of making them sound like general imperatives. They are not. They are my own guiding principles that I use for my own research.

1. *Research in Mathematics Education is the systematic search for ways in which mathematicsal meanings are constructed.* Settings can be scholastic (for example, pupils and teachers) and extrascholastic (for example, working adults). Its methodologies draw on a variety of disciplines such as psychology, sociology, anthropology, philosophy but are, crucially, rooted in mathematics.

2. Studying thinking-in-change is more productive than studying snapshots of thinking. It is often helpful to study thinking which is perturbed by some pedagogical intervention, such as a task, a teaching sequence, or a computational activity.

3. While it is important to study the way people think about mathematics, it is as important to build new kinds of mathematics for people to think about.

4. Methodological eclecticism is OK. But being eclectic does not imply being unsystematic and unrigorous. Mathematics education is an emergent discipline: the range of questions it properly included is still being defined and refined. Methodologies which are appropriate to investigating these questions are still in a state of evolution.

5. Critical review and the construction of theory are major tasks. A crucial aim of the discipline is to construct theoretical bases for research and to build on previous finding. Research can sometimes fail

to build on existing literature, or to seek results which can contribute to existing findings. The posing of research questions ought to be based on strategic decision informed by existing research rather than ignorance. Opinion should be distinguished for research.

6. Mathematics Education needs to draw on other disciplines in a reciprocal rather than subservient way. Mathematics is a fertile field for other disciplines: in the past, psychology has used mathematical learning in this way: philosophy and now sociology have chosen mathematics as a fruitful domain. The problem with using mathematics simply as a site for investigation, is one of epistemology: ofter the knowledge domain it treated simplistically with little or no analysis of content. One of our tasks as researchers is to balance this relationship between mathematics and other disciplines.

Interpretive Research . Barbara Jaworski

> We ... must ... look upon human life as chiefly a vast interpretive process in which people, singly and collectively, guide themselves by defining the objects, events and situations which they encounter .... Any scheme designed to analyse human group life in its general character has to fit this process of interpretation. (Blumer, 1956, p686)

I describe my research as *interpretive* because that seems to be the best of many possible words (two others being *ethnographic* and *constructivist).* The quote above, from Blumer, captures the essence of my research world view.

I have studied in considerable depth knowledge, processes and practices in mathematics teaching, trying in some sense to *characterise* the teaching studied. This has involved close relationships with teachers, observing their lessons and talking with them, informally, at great length - trying to gain insights into the philosophy, knowledge and belief which has motivated their work. The research has also involved conversations with their students, and a small amount of data gathering from students by questionnaire. Most of the field work was audio or video recorded, and further data was collected through stimulus-recall sessions with teachers and/or students and the video material.

Analysis has been through a critical interpretive scrutiny of the data involving recognition of, and accounting for significance, and categorisation leading to theory generation. Interpretations have been verified through triangulation at a number of levels and by respondent validation. Rigour in validation has been ensured through a reflexive accounting process in which interpretations are justified relative to their total situation and context. The *centrality of the researcher*, myself, has been a significant feature of the research.

A central issue in the research has been the rationalisation of theory (both theory brought by the researcher to the research, and theory emerging from the research) with the practices involved. I have seen theory both to inform practice and be informed by it. This theory-practice dialectic has been a

dynamic force both for the advancement of the research and as a strong critique of it.

Important methodologically has been the impact of the research on the teachers involved in it. The attention of a researcher with the habit of asking 'hard' questions has resulted in teachers' critical enquiry into their practice, with subsequent development of their own knowledge and wisdom of practice. Such reflection/development might be seen as a form of research enquiry on the part of the teachers. The recognition of significant events and identification of desired outcomes contributes to a growing spiral of self-knowledge and educated awareness of both teachers and researcher. This is indicative of a methodology commensurate with John Mason's 'Discipline of Noticing'.

The relationship between researcher and teachers has had a significant influence on the research, which might generally be seen as a constructive knowledge-generative process. Despite criticisms levelled against so-called constructivist research, this process is rigorously sound in its overtly critical foundation.

Discipline of Noticing - John Mason

Extra-specting

Survey, Questionnaire	What subjects do
Protocols, Interviews, Observations, Triangulation	What subjects report
Case studies, Longitudinal, Cross-sectional	Locate-validate distinctions
Designed experiment, Treatment pre- post- delayed	

Specting

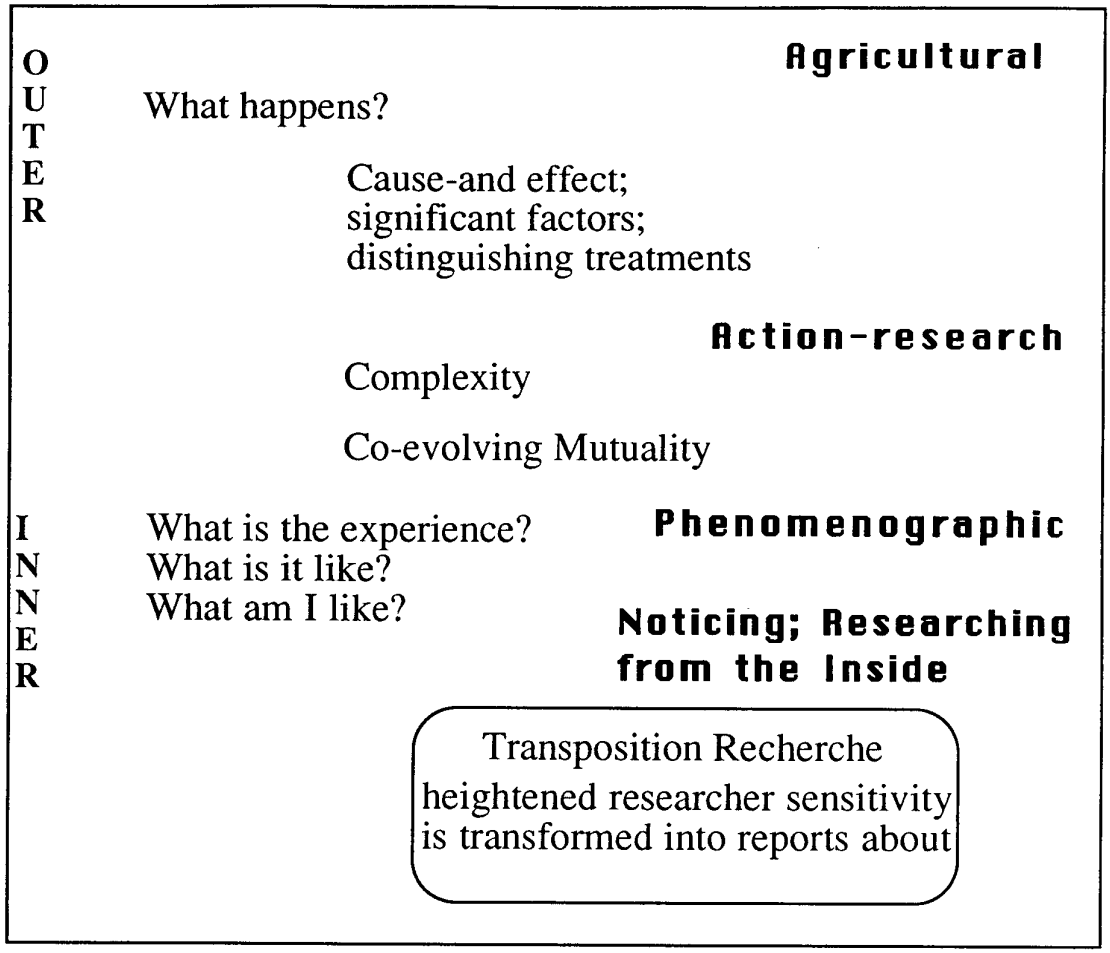
Noticing and Marking in the moment	What I do
Changing habits; Responding not Reacting	What it is like to

Intra-specting

Working on noticing with	retrospective reflective re-entry
	prospective imaginitive entry
Inspecting own experience	

Inter-specting

Exchanging accounts-of with colleagues
Negotiating labels and categories
Trying out focused tasks



Critical summary - Research in Mathematics Education - Steve Lerman

I will make some very brief comments about the ideas presented by Richard, John and Barbara and then widen the discussion to other approaches that are not mentioned here.

Richard talked about what research is for him - an eclectic mix of methodologies in a systematic search for mathematical meanings. He echoed Higginson's (1980) paper on how mathematics education sits within, or draws upon, psychology, mathematics, sociology etc and therefore needs to take account of the developments in those areas. For me there is a problem here, in that the decision as to what constitutes an appropriate method by which to research something is a difficult and serious one, which is largely theoretical. It is tied up with the issue of what constitutes evidence of what one is looking for. For instance, Richard and colleagues developed a research method a few years ago, where they reported on teachers' changing attitudes during an inset course by making fictional characters from compilations fo the real people. I am not criticising the method - I found the reports very interesting rather I want to ask some questions about that (or any other) choice. Why is it legitimate? What is it for? What does it achieve in terms of the goals of the researchers that others wouldn't? I know that Richard has addressed these questions but I ask them as a general observation on eclecticism in research methods. I also want to say that, whilst we are indeed informed by other disciplines, an iTlevitable recontextualisatioon takes place as they are drawn into mathematics education.

John offered a shift from 'outer' to 'inner', and an elaborated language within which to carry the metaphor. He described developing a technique for professional development into a reseach paradigm, that of noticing and reporting on what we all do in carefully specified, disciplined ways involving energetic and vibrant reports. In a shift from more traditional research methods which are used by the community, involving data collection and analysis of one form or another, to a research method which centres on analysis of oneself and one's noticing, the appeal to 'objectivity' is to resonance with the audience. My concern here is with the extreme individualism of this approach, which stems from a radical constructivist perspective. Resonance or its lack are individual interpretations too. I fear that if the audience doesn't resonate with my insights I would be critical of the audience, not my insights. Whilst I want to go along with the implied critique of the objectivity of traditional research methods there is a sense in which the paradigm of noticing is at the other extreme, where the community cannot participate in the evaluation of the research. That said, I do find (sometimes almost against my will!), that I resonate with so much of the work that John and his colleagues report on.

Barbara's focus is on interpretative research, the development of theory in ethnographic study informed by a constructivist perspective. She aims for rigour in a methodology which is made public, offering her interpretations for verification by others and attempting to incorporate the whole context of the research situation. I have some considerable reservations about constructivism, which I will not go into here (see Lerman, in press). The difficulty with theories about teachers' actions is that there needs to be a distiction between the engagement with theory, Barbara's interests, and the theory of practice, which is the concern of teachers. In Barbara's book (1994) the teacher Clare suggests that Barbara's theory about investigative, constructivist teaching is not of any use to her as it disturbs her intuitive feel for the way that she should react in any teaching situation. In theories about practice the gap that researchers observe between espoused and enacted beliefs is the researcher's distinction. The only gap that teachers recognise arises for the the constraints of the teaching situation, a difficult class, poor resources, or constraints imposed by the school system. I make these comments recognising the implied criticism of my own doctoral research of some years ago!

These personal views of their research come from three experienced and well-known researchers, but of course only three views have been presented here. I will mention some others but apologies for very few names - no room! I am interested in research that focuses on the social, cultural setting of mathematics teaching and learning events, and making sense of what individuals do through that lens. There is a substantial body of research from Italy which examines, over a long period, students' learning of mathematics through the use of historical, cultural tools.
Through that work, the researchers are looking at a range of aspects, including children's outside school knowledge, the transfer from school to outside life and vice versa, and I am particularly impressed by the way that they develop the theoretical toolkit that they use in their research, by drawing deeply on the literature. Activity theory also looks through the social activity at individuals, although little has been done in mathematics education using this perspective (but see eg Crawford and Deer, 1993). Studies of discourse in mathematics teaching and learning are also driven, in my view,

by a focus on the crucial role of language in shaping social interactions, rather than expressing inadequately the private inexpressible thoughts of individuals. Similarly studies which draw on semiotics and those which focus on interpretation from other theoretical perspectives, including hermeneutics, try to engage with individual and social meanings. Finally I want to mention the growing interest in enactivism which David Reid on e-mail, describes thus: 'all social construction occurs as part of an embodied enactive ongoing cognition, which permeates even seemingly 'abstract' areas like mathematics'. I'm not sure how that offers new research paradigms but that body of literature is growing and developments should prove interesting.

References

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