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WHAT COULD BE MORE PRACTICAL THAN GOOD RESEARCH?*

ON MUTUAL RELATIONS BETWEEN RESEARCH AND PRACTICE OF MATHEMATICS EDUCATION

ABSTRACT. These seem to be very special times for mathematics education. The public interest in the topic has never been greater. Probably the most prominent among the occurrences that occasioned this recent leap in popularity are international comparative studies such as TIMSS and PISA. The fact that, in spite of the ongoing efforts toward reform in mathematics education, many countries found the results of the international measurements of their students' achievements rather disappointing led the ICME 10 Program Committee to create the Survey Team on Relations between Mathematics Education Research and Practice. The team, coordinated by the author of this talk, and including Aline Robert from France, Ole Skovsmose from Denmark, Yoshihiko Hashimoto from Japan, and Gelsa Knijnik from Brazil, was invited to reflect on the question of how research has been informing the practice of mathematics education over the last decade. Following the invitation, the Survey Team turned to the members of the mathematics education community asking them to answer three queries about their own work: (1) How would you describe the essence of your work in mathematics education over the last 5 years or so? (2) During this period, to what extent was your work stirred and influenced by the current state of mathematics education in your country and/or in the world? (3) Do you think that the work done by you and by your colleagues over the last five years or so had, or is going to have, an actual impact on the practice of mathematics education? Analysis of the 74 responses received from all over the world revealed several interesting trends. This article is the text of the ICME plenary address in which the author presented an "executive summary" of the findings.

KEY WORDS: impact, mathematics education, particiaptionist and acquisitionist paradigms, practice, qualitative and quantitative methods, research

1. WHY TO SURVEY?

Let me open with an anecdote borrowed from Etienne Wenger (1998). A person strolling through the streets of a city comes across two stonecutters toiling over identical pieces of marble. "What are you doing?" she asks.

*This article is based on the Author's plenary report for Survey Team I at the 10th International Congress on Mathematical Education, in Copenhagen, July 6, 2004. ESM editors plan to publish articles based on reports of all survey teams convened for ICME 10. (Editor's note).

Educational Studies in Mathematics (2005) 58: 393–413
DOI: 10.1007/s10649-005-4818-5

"I am trying to turn this stone into a perfect cube", responds one of the workers. "I am building a cathedral", says the other. This story is the perfect parable with which to introduce and justify the kind of task we are going to implement collectively in the next hour. Throughout our professional lives as mathematics educators we are building cathedrals even as we are shaping individual stones. And yet, it is not easy to keep the big picture in mind while going through everyday activities. ICME 10 organizers' decision to launch the survey on what has happened to the relations between mathematics education research and practice over the last few years is an invitation to pause for a moment and try to see the cathedral in what usually appears to us as but a heap of individual bricks.

The wish to engage in this kind of reflection at this particular moment is not surprising. These are rather special times for mathematics education. While the public interest in the topic has never been greater, the press has not always been friendly. Claims could be heard time and again that mathematics education research is "not very influential [or] useful" (Burkhard and Schoenfeld, 2003). In the United States, the criticism has been followed by appeals for teaching "grounded in scientifically based research" and for instructional methods that draw on "reliable evidence that the program or practice works." In particular, the authors of Mathematics and Science Initiative, launched on February 6, 2003, speak about "the need for better mathematics and science education for every child", and declare that perhaps the most important means to this end is "a research base" with which one can "improve our knowledge of what boosts student learning in mathematics and science."[1] Add to this the fact that, in the four years that passed since ICME 9, the world changed almost beyond recognition – enough to mention September 11, 2001; the unprecedented attempts to unify the globe and, at the same time, stronger than ever, the tendency for tearing this globe apart; and the saturation of our lives with wireless communication that irrevocably transforms our conceptions of space, time and human relations – and you cannot but agree that we need to reflect on our past deeds in order to decide what needs to be changed in the future.

2. How to survey?

With such periodic stocktaking in mind, ICME 10 Program Committee created *Survey Team 1* whose members are Yoshihiko Hashimoto from Japan, Gelsa Knijnik from Brazil, Aline Robert from France, Ole Skovsmose from Denmark, and the author of this talk who is well acquainted with both Israeli and North American scenes. The five of us embarked on the project, convinced that answering the question about contributions of research to

the practice of teaching and learning mathematics is a matter of our community's professional accountability.

While always useful, such critical self-reflection becomes a necessity at the times when the quality of the collective cathedral building is being publicly questioned. We thus interpreted our task as guided by the following questions: How well have we been doing as researchers? What do we have to change in order to do better in the future? It did not take long before we became aware of the extreme complexity of the task. After intensive deliberations, we decided that rather than play the role of observers and attempt to tell an "impartial" story of the research community, we would try to help in constructing this community's own account. We turned to our colleagues asking them to tell us their stories. In the fall of 2002, we issued the call to mathematics educators in academia, likely to be involved in research, to answer three questions that are presented here in a slightly abbreviated form:

1. RESEARCH: How would you describe your work in mathematics education over the last 5 years or so?
2. PRACTICE: During this period, to what extent was your work influenced by the current state of mathematics education?
3. IMPACT: Do you think that your work had, or is going to have, an actual impact on the practice of mathematics education?

The questionnaire had been posted on the ICME 10 website. In addition, to ensure a uniform distribution of responses between continents and countries, we had sent a number of individual requests to as many colleagues as our group could reach. Over the next 18 months we were able to collect 74 responses of varying length – from answers in the form of a single paragraph to many-pages long essays. Some of the survey participants joined the community quite recently; some others were "veterans" who have been around for many years and are well known to the rest of us. Through energetic recruiting, not to say nagging, we arrived at a reasonable, if not entirely balanced coverage of the globe (see Table I) Although the sample cannot count as truly 'representative'[2], we are proud of our bulky data base that spreads over six continents and 250 pages.

In launching the survey, our overall aim was to combine the individual responses into a collective narrative. Unfortunately, all I will be able to offer here is an executive summary of our study. In this brief talk I will present the highlights of the findings regarding our three central themes: the current research, practice, and the relation between them. For each highlight, the actor's own story will be followed by another one, told in the participant-observer's voice. This second account

TABLE I
Distribution of responses across continents

Continent	N
Europe	28
South America	15
Asia	14
North America	9
Africa	5
Australia and New Zealand	3

will be more of a commentary than a separate tale. In creating the observer's version I will draw on materials such as other team members' contributions, newspapers, policy documents, research publications, and last but not least, the Team's own speculations. I will complete my discussion by taking a critical look at the past and a hopeful one into the future.

And one last remark. The picture to be presented here is, inevitably, *my* version, *my* revoicing of the community's own story. I cannot even say that it is our Team's narrative because, aware of the immensity and the controversial nature of the task, my colleagues decided in advance to have a number of individual contributions rather than one joint article. Their work can be found on the web (http://www.icme-organisers.dk/st1/).

In the analyses of the data I was helped by Jagdish Madnani, whom I wish to thank. Throughout the rest of this report please keep in mind that although the picture I am painting is a result of the team's work, I am the only person to blame for all of its shortcomings.

3. RESEARCH

To identify recent trends in research in mathematics education we scrutinized the survey participants' responses to the first question, *How would you describe your work in mathematics education over the last 5 years or so*? In our analysis we concentrated on four topics: (a) the prevalent *focus* of research, (b) the dominant *research paradigm*, (c) the *quality* of research, and (d) the academic *identity* of the mathematics educator. The categorizations and the statistical assessments to be reported are crude. There is simply no time in this talk for subtle distinctions. Even national differences in our respondents' stories will have to wait for the extended written version of this report.

3.1. *Research focus*

3.1.1. *Actor's voice*

The first salient feature of the research, as described by the survey participants, is its prevalent focus on the teacher and teacher practice. The initial indication for the teacher's centrality was found in a simple word count: In the responses to our questions, the word *teacher* appeared 832 times, which is nearly three times as many as the 317 appearances of the words *student*, *learner* and *pupil* (some of which, by the way, might refer to preservice teacher!). We then examined the issue in a more direct manner and found out that teacher-centeredness in research could be identified in two thirds of the respondents who claimed to be engaged in research. This is a striking finding, especially when contrasted with the mere one-quarter of the researchers whose investigations focus on the school student.

3.1.2. *Observer's voice*

This finding is significant, as it seems to be showing a considerable change with respect to what was true about mathematics education research in the not-so-distant past. Twelve years ago, in her plenary PME-16 address in New Hampshire, Celia Hoyles deplored the scarcity of teacher-focused research which, at that time, was particularly salient in comparison with researchers' preoccupation with student's cognition. She said:

> Of the 45 papers included in the published proceedings of the third PME conference in 1979, all but three focused on student understanding of mathematical concepts . . . . If the teacher was mentioned at all, s/he was discussed purely as a facilitator . . . . In 1980, the majority of papers again concentrated on [the] student. (Hoyles, 1992)

According to Steve Lerman and Anna Tsatsaroni (2003), students' learning did not lose its place of honor in research of the 1990s. In their insightful study on the development of theories in mathematics education, based on detailed analysis of leading mathematics education journals and PME proceedings in the period 1990–2001, the authors conclude that although there has been a certain growth in publications on teachers and teacher practice, there was no real turnaround.

The decisive shift in research might have occurred in the last four or five years, a period not covered by Lerman & Tsatsaroni's data. We also need to remember that those latter data did not include the specialized teacher-oriented journals, notably the relatively new *Journal of Mathematics Teacher Education*, or special publications such as the 1997 volume of *Recherches en Didactique des Mathématiques* (see, in particular, Margolinas and Perrin-Glorian, 1997), to which most research on teachers might have been channeled. The very fact that such publications were

created may serve as evidence of the growing centrality of the subject. Similar confirmation comes from the proliferation of books on teacher-focused research, many of which became widely popular and some of which stirred public debates (see, e.g., Ma, 1999; Stigler and Hiebert, 1999; Lampert, 2001).

3.2. *Research paradigm*

3.2.1. *Actor's voice*

At least three features are mentioned frequently enough to be regarded as fairly general characteristics of the survey participants' research. First, the basic type of empirical data is a carefully recorded classroom interaction, as opposed to the past attempts to document the learning of the individual student while concentrating on the result rather than on the process of teaching and learning. Second, this research emphasizes the broadly understood social context of learning. The wish of one of our respondents to "systematically analyze and report . . . the messy real-life classroom development" seems typical. Third, the majority of the research is qualitative and does not make any reference to the quantitative argument. As many as 74% of the responses mentioned at least one of these characteristics.

3.2.2. *Observer's voice*

All this shows that the dominant type of research in our sample is one that can be called *participationist*, since it conceptualizes learning as a change in one's participation in a certain type of activity rather than as an ongoing attempt to acquire, or just enrich, a system of individual's internal representations of the world. This latter, more traditional vision of learning will, for obvious reasons, be referred to as *acquisitionist*.

Our respondents' preference for participationist, qualitative research is a phenomenon well known to the incumbent editors of mathematics education journals. Ed Silver, until recently the editor of the *Journal for Research in Mathematics Education*, marvels in one of his editorials that, "These days it seems that mathematics educators are a bunch of quantitatively competent individuals who are inclined to conduct qualitatively oriented studies." With the help of a deftly chosen metaphor, he implies that for some authors, "qualitative" means not much more than "number-free."

This qualitative preference of our respondents is counterbalanced by the increasingly popular international comparative studies, such as TIMSS and PISA, that focus mainly on students' measurable achievements. Only one of the researchers in our sample seems to have been engaged in any of those large-scale projects. Even so, it is quite telling that in our data, we find not more than 3 references to these studies. Our respondents do

TABLE II
Distribution of types of research in mathematics education in the survey sample

	Acquisitionist focus on the *product* of		Participationist focus on *process* of	
			Learning 55%	Teaching
Interventional (teaching experiment)	Process-product (controlled experiments)(19%)		Design experiments (19%)	
Non-interventional (no intended teaching and intervention on the part of the researcher)	Student's (mis)conceptions (7%)	Large-scale achievement comparisons (TIMSS, PISA)(<2%)	Ethnographical studies on learning (classroor norms, development of discourse)	Ethnographical studies on teaching teacher practices; e.g. TIMSS video studies)

not help themselves to TIMSS or PISA findings even when responding to our questions on the state of mathematics education in their countries. The gulf that separates the qualitatively and quantitatively inclined mathematics education researchers appears difficult to bridge, and this is true in spite of our frequent declarations about the need for a balanced mixture of methods.

Table II combines the acquisitionist/participationist distinction with the classification based on the question whether a given study involves an intentional teaching intervention. The numbers present the distribution of the different types of research among the survey participants.

3.3. *Quality of research*

3.3.1. *Actor's voice*

Since research can be defined as an exploratory discourse that aims to interpret and enhance the practice of teaching and learning, the question about the quality of research becomes almost tantamount to the question about the researchers' ability to communicate effectively among themselves and with others. On this all important point, the survey participants sound rather skeptical. With striking repetitiveness, they complain about "fragmented mathematics [education] community", talk about the lack of theoretical infrastructure and about their efforts to provide what is missing by constructing theories of their own, but above all, they wonder about the "reason why it is necessary for authors to coin their own vocabulary." As observed by a number of survey participants, lack of communication entails the impossibility of cumulating and the habit of "reinventing the wheel." The putative communication deficiency is rather puzzling in the view of two other findings: In research, there is a tendency for team work and for mutual inspiration −40% of our respondents report to be working with others and half of them explicitly link their research to the work of others.

3.3.2. *Observer's voice*
With quite a lot of similarities between the individual images of research drawn by our respondents, one might expect the complaint about imperfect communication and insufficient accumulation to be somehow exaggerated. Indeed, there is much convergence in the research focus, there is the general preference for qualitative methods, and there is a wide agreement that research should be socially minded. And yet, evidence gathered in a number of independent reviews over the last few years confirms our survey participants' grievances. Thus, for example, Lerman and Tsatsaroni (2003) summarize:

> [I]t is not uncommon to find a substantial and informed review of literature in an article, in which the range of theoretical resources drawn on by others are noted, but then for the authors not to use any theory themselves, at least explicitly (p. 19).

More often than not, words central to the research discourse – from the most basic, such as *learning*, *understanding*, *meaning*, or *mathematical object*, to more specific, such as *belief*, *identity*, *improvement*, or *disability* are used without being operationally defined, their communicative power taken for granted. And yet, without an operational definition, the reader who is told, "The student did not understand functions" or that "The class built a shared meaning of functions" has no means to unpack the reported findings into what the students actually did or said, and can have no reasonable expectations about these students' future sayings and doings. This kind of research cannot be very effective in informing the practice. As such, it does not live up to its principal commitment, and some would go so far as to say that it does not justify its existence.

3.4. *The identity of the mathematics education academic*

3.4.1. *Actor's voice*
Based on the survey, our professional activities are strikingly numerous and multifarious: 76% of our respondents do research, 56% work as teachers' teachers, 33% are engaged in curricular development and 15% are busy with policy making. No additional statistics are necessary to understand that the mathematics education researcher is often engaged in as many as 3 or 4 additional types of professional activity. The following remark by one respondent echoes a concern expressed in one way or another by almost everybody else in the sample:

> Being overwhelmed, like many of my colleagues, by teaching and other responsibilities . . . , I find it difficult to develop my own research and to keep contact with worldwide research in mathematics education.

It is interesting to see how the researchers position themselves with respect to other actors in the educational drama. Our respondents' remarks about politicians and funding agencies are markedly negative in tone, which contrasts strongly with the caring, warm timbre of their references to teachers. While the politicians and funding agencies are presented as constraining, if not downright oppressing factors, the teacher is portrayed as an ally, a kindred spirit, a partner, a colleague. This egalitarian self-positioning toward the teacher is a rather dramatic change in the research discourse which, only a few decades ago, was imbued with patronizing undertones. Today, the researchers stress that their studies are done *with* the teacher rather than *about* her, that they go to classrooms to listen to the teacher and to think with her rather than to tell her what to do, and that they "support teachers and learners to develop their own powers . . . rather than trying to make changes for them."

3.4.2. *Observer's voice*

The alliance with teachers constitutes the very heart of the mathematics education academic's self-definition and provides his or her professional raison d'être. The tendency toward the dialogical relation with the practitioners may be a result of the growth in the number of researchers who began their careers as teachers. Whatever the reason, there is a remarkable blurring of the boundaries between the communities of researchers and of practitioners.

Interestingly, we seem to be witnessing yet another, apparently less likely, border crossing. Although the external policy makers and funding agencies embody values that the research community tends to oppose, they do seem to have a distinct, and not necessarily desirable, impact on the culture of academia. While under the growing pressure for engaging in large funded projects, mathematics education researchers are sometimes acting more like corporate employees than scholars: They think in "PowerPoint bullets" rather than full paragraphs, write "documents", "memos" and "proposals" instead of articles and books, and replace deep solitary reflection with collective "brainstorming" and "instant" creativity. They even start speaking in the corporate language – with my own use of the term "executive summary" being a case in point.

4. PRACTICE

For the sake of this report, practice of mathematics education has been defined as any kind of activity that belongs to, or results from, the actual learning and teaching of mathematics. While it was risky enough, but still justifiable, to generalize about research, the story of school mathematical

practice involves too many people and societies to try to tell this story in general terms, bracketing national or cultural idiosyncrasies. Not to mention the fact that there are places in the world where school mathematics practice is simply absent, along with the extensive regions that our research has left uncharted. These "other" places, according to statistics quoted by Ole Skovsmose (2004), may be the great majority of the world. After all, says Ole, the dominant, prototypical site of our research is a "well-equipped classroom from countries ranking high on the world's welfare scale." Sadly, UNESCO (2000) statistics let it be understood that great many children in the world may not have access to such classrooms – suffice to mention the 16% of the children who do not attend any school at all. On top of that, whatever I may be able to say about learning and teaching mathematics in those parts of the world where children are born into incontrollable hostilities would probably be misleading, as it would not reflect the fact that in the face of pervasive life loss, when the universe itself appears fragile, the abstract mathematical certainty may have little appeal and there may be no wish to invest in its learning for the sake of future rewards. But let me do the little that can reasonably be done.

4.1. *Actor's voice*

It seems to be generally agreed upon that research in mathematics education is not an end in itself. In their responses to the second survey question, *To what extent was your work influenced by the current state of mathematics education?*, more than half of the participants confirm that it is practice of mathematics education in their country that motivates their work. Close to one third of our sample present a little wider perspective, saying that they are driven by the awareness of social and political wrongdoing, and that for them, mathematics education is a pathway to the much needed socio-political change in the increasingly globalized world.

Exactly half of our respondents express varying degrees of distress with the present state of mathematics education in their country. The other half simply does not offer any evaluation. In general, the complaints vary widely in tone and pitch, depending, mainly, on the nationality of the respondent. Their uneven emotional charge notwithstanding, the grievances seem to converge in their content: They are mainly about classroom practices that refuse to change and, in particular, about the fact that the lessons learned by pre-service teachers do not seem to "transfer" to the actual school classrooms. If there is a reform, say the complainers, it is distorted. Sometimes it seems as if the pendulum of educational change were on its way back to where it was decades ago, especially if its movement is fueled by the back-to-basics slogan.

Another frequent complaint is about a veritable explosion in testing and assessment, evidently driven by the view that "accountability" means liability to measurement. This measuring and labeling tendency is, naturally, not without its consequences, one of the most disturbing of which is the industry of private tutoring, flourishing in those parts of the world where the parents are sufficiently well off. This, needless to say, makes the distribution of opportunities for learning even less equitable than ever.

4.2. *Observer's voice*

Research done by Susanne Wilson, who, in her recent book (Wilson, 2003) tells the history of the reform in Californian schools, confirms the picture drawn by our respondents: Although there is a certain visible change, the American mathematics classroom is rarely a reasonable fulfillment of the reformers' dreams. Wilson describes what she saw in an elementary mathematics classroom:

> . . . there was change. Most teachers . . . added some new practices and problems to their teaching. For some teachers it felt revolutionary. But what seemed radical to them appeared more incremental to us. . . . Other teachers more actively resisted the reforms. (Wilson, 2003, p. 207)

But the voice of outside observers is not just the voice of another researcher. In this last decade, the public debate on mathematics education has been probably more common and much louder than ever. Confronting the broadly publicized, often disappointing, results of TIMSS and PISA, mathematicians, parents, mathematics educators and politicians let themselves be drawn into heated debates on the reform and its impact on students' learning and achievement. The vociferous participants of what came to be known as "math wars" are not any less concerned about the state of mathematics education in their countries than those who are "insiders" to the educational project. And yet, the focus of the outsiders' concern is quite different. While the mathematics education researchers deplore the conservatism of the mathematics classroom, parents and politicians are disturbed by children's low achievement, and the mathematicians worry about the nature of the mathematics learned by the student. While the insider deplores the destructive impact of external forces that counteract implementation of the reform, the others often view the reform as the main culprit. While the mathematics education academics feel for the teacher, who is seen as constrained by the system and unable to act to the best of her understanding, the others do not hesitate to put the responsibility on the teachers' shoulders.

It is notable that while the battles are being fought over the question of who is responsible for the pervasive failure in mathematics, nobody seems

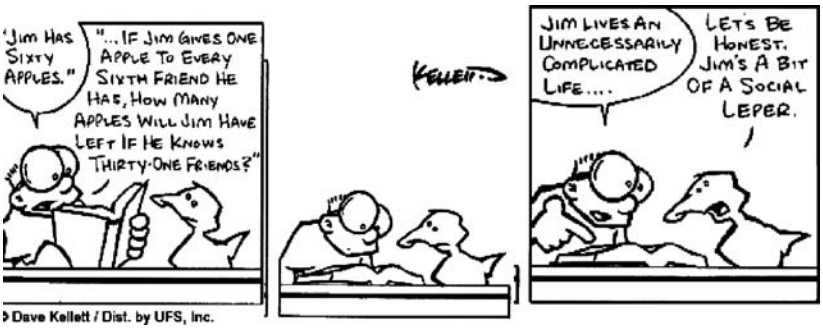

Figure 1. School mathematics in the eyes of a cartoonist.

to consider the possibility that the present cultural climate may play one of the leading roles. Mathematics, once a highly prestigious type of activity, seems to have lost must of its luster and appeal. In the unprecedented flow of books,[3] films,[4] and plays[5] about mathematicians, the protagonist is portrayed as a curiosity, sometimes admirable but always too detached from reality to serve as an example to follow. School mathematics is often ridiculed by the media as a contrived activity that plays no real role in one's life and is practiced only by "uncool," socially ill-adjusted individuals. The comic strip (Figure 1), chosen at random from an infinite supply, is a representative example. Its hero, a 10-year old billionaire, made his fortune in the world of high technology but is still unable to make sense of school math. In the first picture the boy reads a word problem that tells the story of a person by the name of Jim who "gives an apple to every sixth of his friends." After a thoughtful pause the boy concludes: "Jim lives an unnecessarily complicated life", and his friend adds, "Let's be honest, Jim's a bit of a social leper.[6]"

All this leads us to the last question to be dealt with in this report: What is it that shapes the educational practice and its results, and in particular, what is the role of research in making it the way it is?

5. Impact

In the third item of our survey the respondents were asked to *assess the impact of their research on the practice of mathematics education*. Let me report the findings by answering the following three questions: (a) What kind of impact are we hoping for? (b) Do we have an impact? And, last but not least, (c) Can the latter question be answered at all? As before, each query will now be addressed by the actor-observer duet, which does not always sing in unison.

5.1. *What kind of impact are we hoping for?*

5.1.1. *Actor's voice*

In the light of what was said about the centrality of the teacher to the mathematics education researcher's work and identity, it is not surprising that 55% of those who responded to this question hoped to influence teacher practice. The other fields of intended impact, in the order of the frequency of reference, are: society at large (25%), curriculum and educational policy (17%), and other researchers (3%).

5.1.2. *Observer's voice*

The dominant wish to make a difference in teacher practice implies that we came a long way since the time, just a few decades ago, when it was believed that one improves students' learning simply by "fixing" the curricula. In that period, all we expected from research was to show whether this or that instructional idea worked. Our disillusionment with process-product studies is what brought about the participationist-qualitative turn (cf. Silver, 2004). The question that must now be asked is, "Why do we have more confidence in this new type of research, the one that focuses on teacher practices?"

As remarked before, research can be conceptualized as a form of discourse that, if properly constructed, can lead to a reorganization of teacher practice so as to make it more effective. To illustrate this point, let us consider the following episode, in which 7th grade students are discussing the expression 15 000 – 300 w for calculating somebody's dwindling savings as a function of the number of weeks (w) during which the money was regularly spent:[7]

[95] Teacher: Would anyone do anything differently? Martha?
[96] Martha: I'd do 15 000 minus brackets, 300 and number of weeks [writes: 15 000 −(300 w)].
[100] Teacher: . . . All right. Do we need brackets around this? [points to 300 w]
[104] Simon: Yes, you do, because you have to know that there's an operation. A person, now, he'll probably think *300 weeks*, not *300 times weeks*.
[105] Teacher: OK, anyone who now knows algebra will know there is an operation.

The researchers who analyzed this scene concluded that algebraic expressions may have been initially read by the children as abbreviated colloquial sentences, in which letters, such as w, were a shorthand for nouns, such as *weeks*, rather than placeholders for numbers. The teacher was clearly unaware of the children's interpretation. In all likelihood, once she gets

acquainted with the researchers' analysis, her teaching of introductory algebra will change.

The example shows how discursive habits become an obstacle to communication and how research could come to our rescue. The teacher could hardly be blamed for being a captive of her own discursive ways. While in the midst of intensive interaction with a group of children she could not allow herself the luxury of multiple interpretations. To set herself free from the discursive entrapment, the teacher needs a much more detached and relaxed glance at classroom communication – which is exactly what research is all about.

But the emancipatory power of research goes further than that. The established ways of communication also set well-defined limits to one's ability to interpret his or her own experience. The discursive exclusivity of the traditional classroom may be oppressive. Indeed, educational discourses tend to become dangerous if left unchallenged by additional ways of communicating and alternative narratives about the world. Their ostensible innocence, their reputation of being "just words", endows discourses with a great power to hurt. Moreover, unquestioned ways of communicating may turn each one of us into oppressor even as we are acting with the best of intentions. Think, for example, about the way in which the teacher whom I just quoted divided the world into "those who know algebra" and those who don't, signaling the privileged position of the algebra knowers and de-legitimizing the children's query. With this casual, seemingly self-evident utterance, the teacher contributed to the vision of mathematics as a universal yardstick with which to measure, gauge, and compare people. This kind of use turns mathematics into a safeguard of the social order that, in its inner workings, rests heavily on a variety of splits and divides. This order would be in danger without the possibility of distinguishing the "mathematically knowledgeable" from the "mathematically deprived". Once again, the power of educational research lies in its being the art of multiple interpretation. By making clear that there are many narratives to be told about any given instance of educational practice, this research loosens the oppressive grip of old discursive habits and sets us free to consider new options. The next question to ask is how close we have come to attaining this worthy goal.

5.2. *Do we have an impact?*

5.2.1. *Actor's voice*

On the basis of the responses to our last question, I can say that although there is a measure of optimism about research that makes a difference – only 8% said they do not believe their work had any impact at all – there is also

little confidence in the possibility of a decisive, far reaching influence. Even the most upbeat tones are cautious. Those who declare that their work did have an impact (45%) use qualifiers such as *some, certain, little, limited*. Others say that while 5 years is not enough to let an educational innovation take root, they are optimistic, if also a bit leery, about the future.

Not surprisingly, nearly 2/3 of the reported impact is in the domain of teacher practice. Approximately 1/4 of those who claim to have had an influence speak about changes in curriculum and policy. A few respondents mention their contribution to research, and only two people conjecture that their work had a certain impact on the issues of equity and social justice. Whenever impact is mentioned, it is understood that the change is in a desirable direction and nobody seems to consider the possibility of unintended harm.

5.2.2. *Observer's voice*

Lately, there is a sharp increase in studies that feature the word "impact" or "relationship" in their title – and the present survey is a representative example. Probably, in response to the often unsatisfactory results of international achievement assessments and to the subsequent criticism toward all those who are held responsible, there is the easily understandable wish to exhibit some solid, uncontestable evidence for a positive causal relation between the investment and what can count as its outcome.

Although widely spread, this wish may also seem somehow unrealistic. The complexity of the educational machinery precludes the possibility of identifying clear-cut cause-effect relationships. The difficulty with telling the impact does not imply however its non-existence. As stated by a group of social scientists reflecting on their own work, "It would be quite irresponsible to deny the real effects of research in our disciplines," (Cameron et al., 1992/1997, p. 142), and especially those that were neither intended nor envisioned by the researcher. While anything we do is bound to have some effect, the real question is whether this effect is for better or for worse. Yet another question is, "Who is to tell?" This leads me to our last query about impact which, I wish to argue, though not the same, may have a similar answer.

5.3. *Can we tell or foretell the impact of research?*

5.3.1. *Actor's voice*

There is a consensus among the survey participants that the answer is closer to NO than to YES. They all stress the difficulty stemming from the fact that the influence of research is never direct, whereas some deny the very possibility of telling the impact.

5.3.2. *Observer's voice*

The first thing to stress is that the current rapprochement between the researcher and the teacher means, among others, that the impact is mutual rather than one-way: that is, there are cycles of research that observes practice, practice that feeds back and inspires new research and, eventually, research that returns to practice as a modifying agent. Due to the nature of our survey, however, let me focus on the research-to-practice direction. As an observer, but also a participant, I share the position of the more extreme among our respondents and claim that while the existence of our impact is unquestionable, evaluating this impact or controlling it, for that matter, is almost as difficult as trying to predict or to tame the effect of the Hawaiian butterfly on the weather in Boston. Let me explain.

First, the researcher's message must travel through a long chain of mediating factors before it reaches its ultimate end, the student. Even the teacher rarely receives the message directly from the researcher. For one thing, say both Aline Robert (2004) and Susanne Wilson (2003), teachers do not read research reports: They are too busy with everyday chores, and even if they weren't, they would probably be put off by the specialized language, not to say jargon, in which research reports are usually written. Teacher education programs, which could bring teachers and researchers together, are few and far between.

The researcher's message usually comes to the teacher in the form of a policy document, a textbook or an external examination. All these rarely present the rationale for what is suggested and, more often than not, do not reflect the overall spirit of the researcher's advice. In the "broken telephone" exchange of successive re-interpretations the original message is often lost and the practical implications may have little to do with what the researcher had in mind. A good example is our current exaggerated reliance on children's own mathematical inventions – the instructional idea inspired by the Piagetian claim that "children build their own knowledge." The interpreters overlooked the fact that, according to Piaget, learning is one's own construction whatever the teaching method.

The most consequential distortion in the researcher's message is inflicted by mediating factors that are not mere passive transmitters, but active agents who have their own vested interests. Thus, when a government overtakes the role of educational policy-maker, even the direct encounter between the researcher and the teacher may become subject to regulation. One of the survey participants reminds us, in this context, that politicians tend to "devalue research that does not have immediate, obvious classroom implications". Textbooks written with an eye to financial gain are another factor likely to counteract the researchers' message. Assessors and testers, whose voices these days sound stronger than ever, impose their

own curricula. Faced with the assessment frenzy, one begins to suspect that rather than measuring what we believe important, we consider as important what is being measured. Finally, students' own agenda may sometimes override researchers' proposals, forcing the teacher into a discourse quite different from the one she had in mind while entering the classroom. Among the main issues at stake in this context are certain widely accepted norms and values that do not necessarily agree with what the researcher considers necessary for successful learning.

To counter-balance this long message about the bumpy road from research to practice, let me now observe that, imperceptibly, the researcher's message is also traveling on its own. "Any utterance . . . reveals to us . . . words of others," says Bakhtin (1986/1999, p. 131), meaning that discourses penetrate other discourses whether we want them to or not. Through the process of communicational osmosis, the researcher's words are likely to make their way into other discourses. Perhaps this is what one of our respondents had in mind when he said that "changes in education occur by 'stealth'." This means that research, like revolutions, may change the world even when officially silenced. But this also means that our responsibility as researchers may be greater than we think.

6. Looking back critically and ahead with hope

This is the time to try to answer our initial questions. So far, I have played the ventriloquist for actors and observers. In concluding this report, I wish to become myself again and will thus switch to the first person singular. In this way, I will be able to share with you the personal lesson that, as a researcher, I have learned from our survey. It will be up to you to decide whether this has been your lesson too.

The first thing I wish to say is that I am pleased to find out that the last few years have been *the era of the teacher* as the almost uncontested focus of researchers' attention. This is quite a change with respect to the last two decades of the 20th century which were almost exclusively *the era of the learner*. And we have certainly come a long way since *the era of the curriculum*, roughly corresponding to the 1960s and 1970s when the main players in the educational game were the developer and the textbook. I consider the re-conceptualization of the relationship between the teacher and the researcher a big leap toward research that plays a genuine role in shaping and improving practice.

Secondly, I was not surprised by the finding that, as researchers, we are not communicating well either among ourselves or with other communities, notably those of practitioners and policy-makers. In my professional life,

this familiar phenomenon is a source of much frustration. The principal culprit, I suspect, is a certain abuse of the important principle of tolerance toward discursive diversity. Although I have argued for the plurality of outlooks myself, I am also aware that this principle may sometimes be misinterpreted as a license for doing one's own thing without regard for the work of others. This may well be the main reason why educational research does not count as highly potent. Indeed, no cathedral can be built by people who do not understand one another. Let me immediately add that the concern about the effectiveness of communication does not imply the request for a full discursive uniformity. Personally, I interpret it as the need for "conceptual accountability" – the need for being explicit about the ways in which I use words and about how these uses relate to those of others. And if the words are to serve me in research rather than in poetry writing, it would be better if they were defined operationally, so as to make sure that those to whom I speak know how to identify the phenomena I refer to. For this advice to be workable, I feel I need to oppose the trend of 'corporatization', and above all, the corporate interpretation of the term "time-on-task".

Thirdly, my work, like that of the majority of the survey participants, is participationist and qualitative, and this means that rather than trying to arrive at a mechanistic view of "*what* works in the classroom", I focus on *how* things work and try to make myself aware of alternative possibilities. I am also wary of the other kind of research, the one that aspires to tell what works in the classroom and relies too heavily on the power of numbers. Only too often does this type of research seem to honor the principle, "Take care of measurement and the question of what is being measured will take care of itself." In the eyes of a politician, measurement is full of an irresistible appeal: When research results come disguised as numbers, decision-making becomes simple and the decisions themselves appear externally imposed rather than man-made. And yet, the putative scientific reliability of the purely quantitative research is a dangerous illusion: Numerical results, with their reputation of "objective truths," gloss over individual differences, leading to potentially harmful interpretations. Indeed, interpreting quantitative research unassisted by a qualitative outlook is a highly implausible mission – a fact that no politician seems to care about.

Finally, while claiming the impossibility to control or measure the impact of our research, I also claimed that this impact may be greater than we think simply because research discourses have the tendency to infiltrate all the others. This means that our work is consequential not just to the mathematics classroom, but also to society at large. I conclude that if I am not alert and open-minded enough to oppose some time-honored, never-questioned

norms, I may inadvertently spoil more than I improve. Thus, for example, my research may be helping in perpetuating the widespread practice of using mathematics as a gatekeeper and a tool for exclusion. To bar this abuse, I try to combine a continued struggle against mathematical failure with an ongoing protest against measuring people's "quality" according to their achievements in mathematics.

As researchers, we are producing just words. And yet, words are more than sounds. People do things with words, and sometimes what is being done is wrong. When the latter happens, it does not help to say that we had little influence on what was done with our words or that we were unaware of these words' possible misuses. The responsibility for our words and for what is done with them, I believe, is always ours.

ACKNOWLEDGMENTS

My thanks go to those who are, in practice, co-authors of this talk (but who are free from responsibility for its shortcomings), Yoshihiko Hashimoto, Gelsa Knijnik, Aline Robert, and Ole Skovsmose, the members of ICME 10 Survey Team 1; to the colleagues who answered our questionnaire; to Jagdish Madnani, who helped in analyzing the survey responses; and to the first readers of the manuscript, who provided much helpful feedback: Leon Sfard, Nathalie Sinclair, Joan Ferrini-Mundy, Ole Skovsmose and Kenneth Ruthven.

NOTES

1. See http://www.ed.gov/rschstat/research/progs/mathscience.
2. Surprisingly or not, however, the distribution given in Table I (in percentages: Africa – 7%; Australia & New Zealand – 4%; South America – 20%; North America – 12%; Asia – 19%; Europe – 38%) is not very far from the distribution, across continents, of speakers at a PME conference held in Europe, for example the 26th Psychology of Mathematics Education conference in Norwich, UK, in 2002 (the corresponding percentages are 2%, 8%, 13%, 17%, 19%, 42%): the linear correlation coefficient is about 0.93. (Editor's note)
3. See, for example, Silvia Nasar's (2001) *The Beautiful Mind*, Paul Hoffman's (1999) *The Man Who Loved Only Numbers*, Apostolox Doxiades' *Uncle Petros and Goldbach Conjecture* or Simon Singh's (1998) *Fermat's Enigma*.
4. *The Beautiful Mind, Good Will Hunting, Pi*.
5. See, for example, *The proof* by David Auburn.
6. www.comics.com/comics/sheldon.
7. The episode is taken from a study by Carolyn Kieran and Anna Sfard and is described in (Sfard, 2000). For more details about the study see (Kieran, 1994) and (Sfard and Kieran, 2001).

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